VOL. 16 · MARCH 1958 · NO. 2

A JOURNAL
DEVOTED TO THE ART
AND SCIENCE OF
ORAL SURGERY

JOURNAL OF ORAL SURGERY

Fred A. Henny, D.D.S., Editor
HENRY FORD HOSPITAL, DETROIT

Journal of Oral Surgery, Vol. 16, No. 2, March, 1958. Published by the American Dental Association, 222 East Superior St., Chicago 11, Ill. Yearly subscription $10.00 for U. S. and possessions, $12.00 for foreign countries. Single copy $2.00. Entered as second class matter June 21, 1943 at the post office at Chicago, Ill., under the Act of March 3, 1879. Published bimonthly. Copyright 1958 by the American Dental Association. The Journal of Oral Surgery is indexed in Index to Dental Literature, Quarterly Cumulative Index Medicus and the Current List of Medical Literature.

Scientific Articles

THE MANAGEMENT OF IMPACTED TEETH
James R. Cameron 93

PRINCIPLES OF ALVEOLECTOMY
J. R. Hayward and Seth Thompson 101

CONTROL OF POSTOPERATIVE EDEMA
Edward C. Hinds 109

ANTIBIOTICS IN ORAL SURGERY: A REVIEW
Marvin Revzin 119

CONTROL OF POSTOPERATIVE PAIN
Edward C. Thompson and Charles R. Morris 126

PREMEDICATION AND SEDATION FOR THE SURGICAL PATIENT
L. W. Peterson and C. E. Haynes 131

GENERAL ANESTHESIA FOR THE AMBULATORY PATIENT
William T. Ewing and Dorral D. Berry 137

CONTROL OF POSTOPERATIVE HEMORRHAGE
Robert B. Shira 144

Case Reports

CHRONIC OSTEOMYELITIS OF THE MANDIBLE
Richard L. Verbic and Sunder J. Vazirani 160

PERIPHERAL ODONTOGENIC FIBROMA WITH CEMENTOGENESIS
Norman Buckman 163

MIXED TUMOR IN AN EIGHT YEAR OLD CHILD
George Stinson and Robert I. Scileppi 167

EDITORIAL 170

QUERIES AND COMMENTS 171

BOOK REVIEWS 173

CURRENT LITERATURE 175

ANNOUNCEMENTS 177

LON W. MORREY

Editor in Chief of Publications—American Dental Association

FRED A. HENNY

Editor—Journal of Oral Surgery

EDITORIAL BOARD

Malcolm W. Carr, 1959, New York
James R. Hayward, 1958, Ann Arbor, Mich.
Fred A. Henny, 1958, Detroit
Sanford A. Moose, 1958, San Francisco
Lon W. Morrey, 1959, Chicago
LeRoy W. Peterson, 1959, Clayton, Mo.
Robert B. Shira, 1960, Washington, D. C.
P. Earle Williams, 1958, Dallas, Texas

CONSULTING EDITORS

Don H. Bellinger, 1958, Saginaw, Mich.
James R. Cameron, 1959, Philadelphia
L. M. FitzGerald, 1959, Dubuque, Iowa
J. Orton Goodsell, 1960, Saginaw, Mich.
V. H. Kazanjian, 1960, Boston

ASSOCIATE EDITORS

Albert A. Antoni, 1958, Toronto, Canada
Lyle F. Aseltine, 1958, Ann Arbor, Mich.
Joseph L. Bernier, 1958, Washington, D. C.
Herbert J. Bloom, 1958, Detroit
H. Newman Brownson, 1959, Hollywood, Calif.
Horace L. Cartee, 1959, Miami, Fla.
George W. Christiansen, 1959, Grosse Pointe, Mich.
Bruce L. Douglas, 1959, Rego Park, N. Y.
G. Thaddeus Gregory, 1960, Indianapolis
Merritte M. Maxwell, 1960, Jersey City, N. J.
Leonard M. Monheim, 1960, Elizabeth, Pa.
Ralph G. Peterson, 1960, Minneapolis
John J. Stetzer, Jr., 1960, Philadelphia

INTERNATIONAL ASSOCIATE EDITORS

George Christensen, Brisbane, Australia
C. Funcia Cornell, Havana, Cuba
Juan E. Dillon, Buenos Aires, Argentina
Karl-Erik Hogeman, Stockholm, Sweden
Terence G. Ward, Sussex, England

VOLUME 16 • MARCH 1958 • NUMBER 2 JOURNAL OF ORAL SURGERY

The management of impacted teeth

■ *James R. Cameron, D.D.S., Sc.D., Philadelphia*

The removal of impacted or malposed teeth is one of the most frequent surgical procedures an oral surgeon is called on to perform. The removal of such teeth is often a difficult procedure calling for extreme skill and judgment if complications are to be avoided.

Careful planning of the operation based on a study of the involved anatomy relative to the amount of overlying obstructing bone, the position of the impacted tooth in regard to adjacent teeth, and the nerve and blood supply is most essential. One or more roentgenograms will aid in determining the exact position which the tooth occupies and the amount of osseous structure that must be removed before delivery of the tooth can be accomplished.

It is unfortunate that the removal of impacted or malposed teeth is too often undertaken lightly by those of limited surgical experience. The use of the new more potent local anesthetic agents frequently encourages inexperienced operators to attempt procedures beyond their surgical ability. Improved general anesthetics, affording almost unlimited operating time, also may tempt an operator of mediocre ability to go beyond the bounds of good judgment in attempting an operation which a more skillful surgeon would accomplish in less time and, consequently, with less trauma to both the soft and osseous structures.

Malposition of the third molars and cuspids is one of the most frequent variations from normal occlusion. These teeth are the last to take their place in the alveolus, and when there is a lack of development of the jaws, there is insufficient space for them to take their normal position in the dental arch. The third molars are often malposed, impacted or underdeveloped. Arrested or inadequate development of the jaws restricts the amount of room available for the eruption of the third molar, preventing it from assuming a normal position in the alveolar arch. Some investigators feel that the process of evolution is the reason teeth fail to erupt into normal occlusion. Increased density of developing bone is probably one reason for the lower third molar's being

more frequently malposed or impacted than the upper third molar, situated as it is in bone of lessened density. Deviations during embryologic development may account for such abnormalities as inverted teeth or those outside the dental arch.

Impacted teeth are subject to various pathologic disturbances which necessitate their removal. Reflex pain due to pressure may be manifested in headaches, earache and eye pain, and pain in the posterior cervical region is not uncommon. Resorption of an adjacent tooth with resultant caries of both teeth is seen frequently. Cystic formation arising from a persistent developmental sac may become extensive before discovery or before acute symptoms of an infection arise.

One of the most common disturbances which an oral surgeon is confronted with is that of local inflammation of the soft tissues overlying an unerupted lower third molar. This may be caused by an elongated upper third molar traumatizing the gingival tissue overlying the lower third molar, thereby creating inflammation. Bacterial invasion and accumulation of food debris beneath the gingival flap subsequently result in a painful condition which is not always confined to the traumatized tissue, but may extend to the adjacent musculature causing trismus and painful deglutition.

Inasmuch as this is usually an acute suppurative condition involving the soft tissues, removal of the tooth during this inflammatory period is not wise. It is not a confined bone infection requiring drainage. Removal of the tooth at this time may result in the infection's entering the uninfected cancellated bone structure causing osteomyelitis, or migrating into the deeper adjacent soft tissues with a resultant peritonsillar or submaxillary abscess and, at times, Ludwig's angina.

Conservative treatment by irrigating beneath the swollen gingival flap to remove all debris and the instillation of an antiseptic of choice, plus the use of adequate antibiotic therapy, usually will bring about resolution. Relief of the cusps of the upper third molar to avoid further trauma and the frequent use of a hot saline mouthwash are beneficial. In such instances, the prescribing of antipyretics and sedatives, forcing of fluid intake and a cleansing enema or laxative will make the patient more comfortable. The offending tooth can then be removed safely after the acute inflammation of the soft tissue has subsided.

A lower third molar or lower cuspid may be malposed and impacted to the extent of impinging on the mandibular canal. In this instance, referred pain may be the patient's chief complaint rather than a complaint of pain in the region of the impaction. Prior to removal of a tooth in this position, the patient should be advised carefully that anesthesia of the lip may follow the operation no matter how skillfully the removal is executed. The numbness may last for several weeks or months or even longer, and the patient should be informed that no one can state how long it will persist. In most instances of lip numbness, however, sensation is regained gradually in a few weeks.

The impacted third molar frequently exerts a tremendous force on the teeth in the dental arch. Many orthodontists consider early removal of impacted third molars to be a distinct advantage in carrying out orthodontic treatment. It is widely

recognized that retention of impacted third molars that are so situated that their eruption is impossible may ruin an otherwise fine result of orthodontic treatment and cause a relapse of malocclusion.

It is difficult to explain why an impacted tooth may remain dormant for years and later undergo certain pathologic changes. This condition has been observed on numerous occasions and has presented a problem more serious and complicated than would have been the case had removal been accomplished earlier in life and prior to development and extension of infection into adjacent structures. Possibly, lowered resistance in patients of advanced age with metastasis by way of the blood stream is the answer. I removed an impacted lower third molar for an elderly patient; the tooth was felt to be the cause of intermittent earache. The molar was completely buried in bone and no bone destruction showed in the roentgenogram. Neither was there any inflammation of the soft tissue prior to surgery. The wound failed to heal in a normal manner and rapidly filled up with what appeared to be granulation tissue. Roentgenographic examination of the region revealed a rather extensive destruction of bone suggesting a localized osteomyelitis. The clinical picture, however, was not one that pointed to such a diagnosis. A biopsy section of tissue from the operative region revealed carcinoma of metastatic origin. Further examination of the patient revealed an unsuspected carcinoma of the prostate gland.

■ *Removal of Impacted Teeth*

Whether all impacted teeth should be removed is a difficult question. Anyone in practice many years must have observed impacted teeth which were causing no demonstrable trouble. It would seem in such instances unjustifiable to advise removal of such teeth, yet they must be considered as a potential source of trouble if the patient lives long enough. On the other hand, many people carry impacted teeth throughout their lives and never experience any difficulty with them. Impacted teeth that are asymptomatic should be checked periodically by a roentgenogram to determine if any changes are occurring in either the position or the osseous structure. Should changes in the position of the tooth or surrounding bone be demonstrated, removal would seem advisable even though the patient is not complaining of any symptoms.

A fundamental knowledge of surgical principles and good surgical judgment are far more important than the method that is used in the removal of an impacted tooth. As stated earlier in the paper, a careful clinical and roentgenographic examination is essential. The age and general physical condition of the patient are likewise important, since the operation is one that must be considered a definite surgical procedure involving more than an uncomplicated tooth extraction. The operation must be considered a precise one, and all surgical and aseptic precautions should be exercised throughout the operation as is expected in surgery of any kind.

The operative field should be cleansed of all gross sepsis with tincture of mercocresols. The next step is the designing of a proper mucoperiosteal flap.

The incision through the gingiva should extend down to the bone. The flap should be so designed that it can be re-

flected away from the operative field where obstructing bone must be removed in order to deliver the tooth from the jaw.

Preservation of the blood supply is most important in designing a flap. If the blood supply to a raised flap is lost, necrosis of the flap in part or *in toto* will occur.

The flap should be so designed that it can be returned to its original position and completely cover the operative site. The buccal incision in a properly designed flap for exposure of a lower third molar impaction should be made at approximately the mesial surface of the second molar and carried around the cervical margin to, and extend posteriorly in, the retromolar triangle. A flap so designed assures protection to the distobuccal angle of the second molar when it is returned to place. The flap may be secured with a suture if the operator considers this advisable.

Removal of the overlying obstructing bone is accomplished by means of suitable bone cutting chisels or by the use of a surgical bur. The decision whether to use a chisel or a bur will depend largely on the experience of the operator in the use of these instruments. I prefer to use a Barry no. 6 chisel and a Gardner hand mallet. The operator himself should use the hand mallet; the sense of "touch" is lost when an assistant uses it.

Mandibular third molars occupying a mesioangular position often may be sectioned in the long axis by a single-bevel, appropriate-sized chisel, thereby reducing the amount of bone to be removed before delivery of the tooth by means of an elevator. Lower third molars in a horizontal position may be sufficiently accessible to permit sectioning of the crown at the cementoenamel junction. This may be done with a sharp, single-bevel chisel or a cross-cut bur.

After delivery of the sectioned tooth or the tooth *in toto*, all debris, including the adherent residual developmental sac, should be removed, bleeding points controlled and bone edges smoothed before replacing the flap. If the flap has been well-designed, it will return to place and completely cover the operative field and protect the distobuccal angle of the second molar. Suturing of the flap is not routinely done, although, on occasion, one suture may be used to aid retention of the flap in position.

The routine use of a gauze drain in the wound has long since been discarded, as it slows the healing process. Occasionally, unusual hemorrhage may indicate the need for a gauze pack or insertion of absorbable gelatin sponge in the socket to control the bleeding. In most instances, troublesome, persistent hemorrhage after removal of the tooth can be controlled by suturing the flap across the retromolar triangle. A normal, clean, well-established blood clot in a wound having received a minimum amount of surgical trauma will lessen the time required for healing to take place. The use of penicillin, 300,000 units intramuscularly, before and after the operation, reduces the incidence of secondary infection which may otherwise invade the blood clot.

In a few instances, degeneration of the blood clot will take place on the third or fourth postoperative day. When this occurs, the broken-down blood clot should be removed gently by means of a curet and the wound irrigated with a

warm saline solution. A drain of iodoform gauze, ¼ inch wide, saturated with equal parts of Camphophenique and oil of cloves, is then inserted loosely into the operative defect. Continuation of penicillin therapy is indicated in such instances, and the dressing is removed in 48 hours. A sedative dressing is applied each second day until the patient is comfortable and healthy granulation tissue is noted in the socket.

The prescribing of sedatives postoperatively is not routine practice, although in highly nervous, apprehensive patients with a low tolerance for discomfort a sedative of choice may be advisable. A prescription given the patient for relief of postoperative pain may be written as follows:

Codeine sulfate, ½ grain
Phenacetin, 1 grain
Acetylsalicylic acid, 5 grains
Disp: Capsules, 6
Sig: One capsule for relief of pain. Repeat in three or four hours as necessary.

I have found that the use of antihistamine preparations for lessening postoperative edema has not proved to be of any particular value. Careful, nontraumatic surgery is the best insurance against excessive postoperative edema. Patients who are subject to various degrees of ecchymosis after any contusion are benefited by taking ascorbic acid, 250 mg. every six hours, for two or three days.

During the first eight hour postoperative period, patients are restricted in the use of a mouthwash, since frequent rinsing of the mouth immediately after surgery will often prevent adequate blood clot formation. An ice cap placed externally over the wound immediately after the operation affords comfort to the patient and may be repeated every three or four hours for the first 24 hour postoperative period. A soft diet of the patient's choice is permitted, although intermittent feedings between regular meals are recommended.

In wounds that do not require a sedative dressing, observation and gentle irrigation of the wound is carried out every third day until healing has progressed sufficiently to allow routine patient home care. The majority ot patients can be discharged within ten days.

The same principles as outlined previously can be followed when impacted cuspids are removed from the palate. The palatal flap is designed by making an incision in the midline of the palate, starting opposite the first molar tooth and extending forward to and around the incisal pad to the cervix of the incisor tooth. The cervical margin of the central and lateral incisors and bicuspids is freed to permit reflection of the flap containing the anterior palatine artery. With the flap retracted posteriorly, the palatal bone is exposed and a window of appropriate size is cut to expose and permit removal of the impacted tooth, either *in toto* or after sectioning at the cementoenamel junction. Replacement of the flap can be secured by one suture (black silk) taken just posterior to the anterior margin of the flap and tied around the central or lateral incisor.

■ *Complications*

The removal of impacted teeth, especially the mandibular and maxillary third molars, may be complicated at times by the fracture of tapered or curved root apexes during the removal of the tooth.

If visible, they can usually be removed without difficulty, but there are times when a fractured root apex cannot be seen although a wide exposure is present.

Working blindly in an attempt to displace and remove such a fractured apex is to be condemned. Persistent blind "digging" all too often results in excessive trauma to the osseous structures with likely invasion of the mandibular canal and its contents; this causes excessive hemorrhage which further complicates the procedure and damages the nerve supply within the canal.

The root sometimes may be displaced unseen and forced through a thin lingual plate to a position medial to the mandible and below the mylohyoid ridge. If the root has been forced through the lingual plate and cannot be seen through the perforation, it is necessary to retract the lingual gingival tissue from around the lingual surface of the second, and possibly the first, molar to permit freeing it from the mylohyoid ridge in order to give sufficient exposure for its recovery. Care must be taken to identify and protect the lingual nerve from injury when this procedure is followed.

If a fractured root apex of a mandibular third molar cannot be seen after a reasonable atraumatic attempt has been made to locate and remove it, the operation should be discontinued until adequate roentgenographic study can be made. When the position of the root is determined, the root may be removed at a second operation.

Fractured apexes of an upper third molar may present similar difficulty in removal, and blind exploration may result in forcing the root into the maxillary sinus or beneath the periosteum of the palatal mucosa. These complications, as outlined, raise the question whether all such root apexes should be removed. The ideal operation, of course, is one that has accomplished removal of the entire tooth with a minimum amount of trauma to the osseous and soft structures. There are, however, exceptions and, at times, it would seem that the best interests of the patient can be served by permitting the root apex to remain rather than cause troublesome complications by persistent attempts at removal. Fractured, vital root apexes remaining in the jaw seldom cause later complications.

Displacement of an entire mandibular third molar into the region inferior to the anterior faucial pillar may occur because of fracture of the lingual plate. Should this occur, the tooth must, of course, be removed. The index finger is placed below the mylohyoid ridge, posterior to the faucial pillar. On feeling the tooth, the operator gently forces it back into the open wound where it can be grasped with a curved Kelly hemostat and removed. The fractured lingual plate, if sufficiently attached to soft tissue to insure its nourishment, may be pressed back into position, and normal healing may be expected. If the lingual plate is detached and ragged, however, it is advisable to free it completely of soft tissue and remove it.

The impacted upper third molar situated as it is within thin bone may, on attempted removal, be forced backward into the pterygomaxillary fossa. Recovery of the tooth may be difficult because of the vascular and fatty tissues that are present in this region. Inadequate visuali-

zation of this region adds to the difficulty of locating the misplaced tooth in order to remove it. Working space in this region also is restricted, because when the patient's mouth is open, the coronoid process obstructs any attempt to approach the region properly. Recovery of such a misplaced tooth will usually require extension of the original incision posteriorly and also anteriorly into the buccal vestibule in order that adequate retraction of the soft tissue may be accomplished. With the mandible deviated to the side of the operation, careful blunt exploration with a curved Kelly hemostat can be carried out until the tooth is located and grasped in the beaks of the forceps and removed. Fracture of the buccal alveolus in removal of an upper third molar is treated the same as alveolar fractures in the lower third molar region.

An extraoral approach may be advisable, or even necessary, to remove certain impacted third molars, bicuspids and cuspids. Such a procedure is not common, but there are occasions when an external approach is the method of choice for removal of teeth lying in, or slightly above, the mandibular border. External removal of an impacted tooth situated deep in the mandible may lessen the possibility of producing a fracture or damage to the mandibular canal. Most fractures of the mandible occur during removal of an impacted third molar because an insufficient amount of obstructing bone was removed prior to the use of an elevator. Obstructing bone should be removed and the tooth seen to loosen before any attempt at elevation of the tooth is made.

If a fracture of the mandible should occur, the tooth should be removed as gently as possible in order to avoid displacement of the bony parts. The wound is cleansed of all debris and the flap sutured. After alignment of the parts, if they are displaced, intermaxillary fixation is accomplished and the condition treated as a fracture.

An impacted maxillary third molar that has been accidentally forced into the maxillary sinus and cannot be seen or reached through the perforation is best removed by opening a window into the sinus through the canine fossa. The third molar incision can then be tightly closed by suturing and will usually heal without forming an oroantral fistula. The flap made in the canine fossa is likewise sutured. It is not necessary to insert a drain in either wound when the maxillary sinus is free of infection.

Secondary infections extending into the soft structures below the mylohyoid muscle and into the submaxillary triangle occasionally follow removal of impacted lower third molar teeth. When these infections threaten and are observed early, they may be controlled or entirely aborted by the use of antibiotic agents given in sufficient dosage at the first sign of infection invading the regions mentioned. There will be times, however, when incision and drainage of the involved region will be necessary.

Osteomyelitis of the mandible after third molar surgery may be completely aborted or localized by the use of antibiotic therapy. The most frequent cause of osteomyelitis after third molar surgery is due to excessive trauma and introduction of infection during the operation. Removal of an impacted third molar when an acute pericoronitis is present or the in-

jection of a local anesthetic solution into, and through, an infected region has resulted in most of the instances of postoperative osteomyelitis seen of late. Although antibiotic therapy may lessen the severity of the disease, a slowly developing, low-grade, destructive osteomyelitis of the ascending ramus of the mandible may occur.

■ *Summary*

The decision as to what should be done about an impacted tooth or teeth is one that can only be arrived at after careful study of the patient as a whole, and consideration of possible pathologic disturbances such as damage to adjacent teeth or pressure causing changes in occlusion. The likelihood of cystic formation slowly developing in an asymptomatic manner must also be considered. The decision reached must be based on experience; and when removal is decided on, the operation should only be undertaken by one having full recognition of the problems involved and the possible complications that may occur. Surgical skill and judgment are paramount, and the surgeon should be prepared to recognize impending complications and know how to avoid them or manage them successfully if, and when, such complications occur.

Patients with multiple impactions or those which are located deep in the jaws and involve important structures should be hospitalized and the operation performed under general anesthesia. The removal of a deep-seated vertically impacted mandibular third molar must always be approached with care, as fracture of the mandible may occur more readily during removal of this kind than in most other third molar impactions. Hospitalization of patients requiring removal of multiple impacted teeth enables the patient to have one operation performed under conditions of rigid asepsis rather than a series of office operations performed in less beneficial surroundings. The patient also has better controlled preoperative and postoperative care when hospitalized. The management of such patients, when hospitalized, is less of a nervous ordeal to the patient, and the recovery period is shortened materially.—*269 South Nineteenth Street.*

■ THE MEDICAL BOOK

The medical book is still the cornerstone of the monumental fortress of medical knowledge in our atomic age, as it was in Vesalius' time. Medicine is a science whose progress is announced in medical journals but is consolidated only in books.—*Félix Martí-Ibáñez, Books in the Physician's Life.*

Principles of alveolectomy

■ *J. R. Hayward,* D.D.S., M.S., and*
Seth Thompson,† D.D.S., Ann Arbor, Mich.

Any operation of worth is based on knowledge which indicates that the patient will derive definite benefit by correction of the diagnosed condition. Operative procedures are based on sound surgical principles and knowledge of the processes of regeneration and repair and of the future function of the operative site. Local and systemic variations in individual patients, however, may prevent the routine application of standard surgical technics. The management of individual variations demands the important quality known as surgical judgment. Within these rational boundaries of operative procedure, the surgical preparation of the alveolar osseous structure, known as alveolectomy, will be reviewed. Although the literal connotation of the term means excision of the alveolar process, in its practical usage the term designates the preparation of alveolar ridges for reception of dentures. The alternative terms "alveoloplasty" and "alveolomerotomy" also are used to describe the surgical alteration of the alveolar process to a more desirable form.

■ *History*

The history of most operative procedures seems to follow a cycle. Initial slow acceptance is followed by increasing interest, which may reach universal acceptance. Abuses and poor applications frequently follow, with a subsequent wave of reaction during which all indications for the surgical procedure are challenged. If the operation has true merit, its future applications thereafter will have more specific indications, and patients needing the service will continue to benefit. The procedure of alveolectomy has completed this cycle in dental practice in the United States.

A. T. Willard of Chelsea, Mass., described alveolectomy after tooth extraction in 1853.[1] He advocated the reduction of the alveolar process in order to accomplish complete approximation of soft tissues over the ridge. This goal is questionable in view of the principles which will be described later.

In 1876, W. George Bearce of Montreal, Canada, described the "heroic treatment" of alveolectomy in order to assist nature in the remodeling of the arch.[1]

In 1905, William Shearer performed and advocated alveolectomy in the literal sense of the term. His recommendation for complete elimination of the alveolar process is based on an interesting concept. The following was the rationale for his radical approach:[2]

> . . . . if the resorption of the alveolar process does not occur and the cortical tissue of bone

*Professor of oral surgery, University of Michigan School of Dentistry.

†Intern in oral surgery, University of Michigan Hospital.

1. Molt, F. F. Surgical preparation of the mouth. J. Oral Surg. 7:20 Jan. 1949.

2. Shearer, W. L. History of alveolotomy and partial alveolectomy and management of pathological conditions of the jaws. Chron. Omaha Dist. D. Soc. 13:127 Jan. 1950.

is slightly hard, thus precluding the possibility of normal absorption taking place, decomposition of the cells of the alveolar process takes place and remains in the body of the jaws forever as a low-grade infection.

Shearer's frequent references to alveolar cancellous bone as a pathological entity in the jaws is unusual if not incredible.

Much has been written concerning the technic of O. T. Dean.[3] In this instance the principal departure from previous technics entails "intra-septal alveolotomy" in which the central portion of the alveolar ridge is removed by cutting out the interseptal bone. The cortical plates are then compressed in order to eliminate the prominence of the labial and buccal aspects of the alveolar process. The advantages claimed for this technic are the preservation of the cortical plate, with the elimination of undercut areas and the preservation of the intact periosteum, without disturbing the muscle attachments. Modification of the technic includes making a "V" incision in the labial cortical plate over the cuspid socket in order to avoid buckling when the plates are collapsed. Additional modifications include the collapse of the cortical plate by pressure or by tapping with a round-ended piece of wood with mallet force. Minor irregularities are also reduced by the use of this malleting technic over the intact mucosa. There are many advocates of the technic of intraseptal alveolotomy.

Additional contributors to the technics of alveolectomy have been numerous, but the departures have been minor.

■ *Functional Alterations of the Alveolar Process*

The fundamental role of the alveolar process is to support the teeth, but it has numerous other dynamic functions. The response of alveolar bone to functional stresses is a common clinical example. Expansion and growth of the alveolar process to support the teeth during normal eruption, functional or orthodontic repositioning and abnormal extrusion are familiar clinical observations. The physiological alterations imposed by the loss of teeth are reflected in dramatic alterations in the masticatory system. Alveolar atrophy is only a part of this physiological change. Loss of periodontal membrane perception disturbs the neuromuscular and temporomandibular joint components of the masticatory system as new relations are established.

The process of wound healing after the removal of teeth is complex. The following events occur: (1) establishment of a blood clot, (2) proliferation of fibroblasts and angioblasts to organize granulation tissue, (3) maturation of connective tissue and its replacement through osteoblastic activity by coarse fibrillar bone, (4) resorption of the lamina dura and replacement of immature bone with mature bone possessing functional orientation of the trabeculae, (5) resorption of variable amounts of alveolar bone and formation of cortical bone over the ridge crest and (6) further atrophic changes and osteoporosis from lack of function, which may proceed to complete atrophy of the alveolar process.

The later stages of the healing sequence after the removal of teeth are relative. The degree of atrophy will depend on the following factors: (1) individual

3. Dean, O. T. Intra-septal alveolotomy. D.J. Australia 13:172 April 1941.

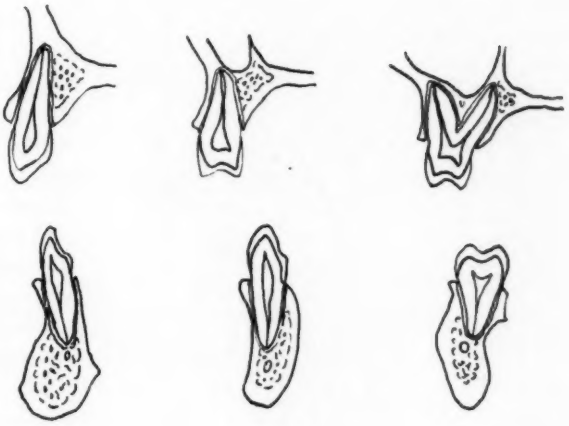


Fig. 1—Average distribution of alveolar bone in various regions of jaws. Above left: Maxillary cuspid. Above center: Maxillary second bicuspid. Above right: Maxillary first molar. Below left: Mandibular incisor. Below center: Mandibular cuspid. Below right: Mandibular molar

qualities of bone metabolism influencing degrees of calcification of the osseous matrix, resorption of "hypocalcemic" bone generally being more rapid and extensive than that of normal or "hypercalcemic bone,"[1] (2) the contour of the remaining alveolar process and the changes of functional trajectories in response to new stimuli and (3) the application of new functional stimuli through the support of denture prosthesis. A minimum of delay in the application of balanced functional stimulation of the alveolar ridge by properly designed prosthesis will tend to limit the resorption phenomena.

It should be remembered that bone is the most dynamic of tissues and is under continuous remodeling in response to various stimuli. Osteoblastic activity follows functional stimulation up to the physiological limits. Excessive forces may exceed such limits and induce the osteoclastic phenomena so familiar in certain periodontal conditions and in instances in which the alveolar ridges are overloaded with prosthetic pressures. The extreme anterior alveolar ridge atrophy which occurs under a maxillary complete denture opposed only by lower anterior teeth is a classic example of the effect of these phenomena. In addition to local influences, alterations may be induced through factors of general bone metabolism. Such factors may defy accurate prediction of the behavior of the alveolar osseous tissues in any particular patient.

The functional behavior of the alveolar process in the presence and absence of teeth has been reviewed. The current concepts of alveolectomy may be discussed.

■ *Objectives of Alveolectomy*

CONTOURING OF THE ALVEOLAR RIDGE WITH MULTIPLE EXTRACTIONS—The average relations of the teeth and the alveolar process in various zones of the dental arch are shown in Figure 1. Instances may exist in which the removal of teeth may be accomplished without the necessity of alveolectomy. Since conservation of osseous alveolar process is axiomatic, the technics used for the removal of teeth must follow principles of controlled force.

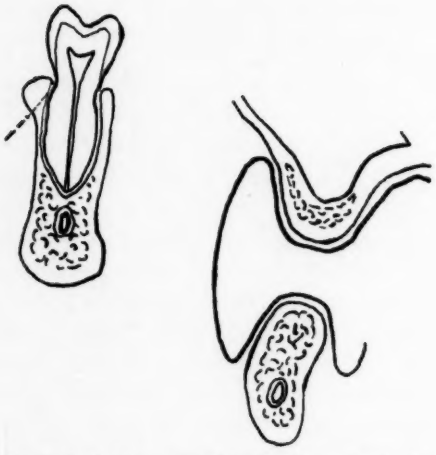


Fig. 2—Left: Heavy cortical roll of bone at alveolar crest engaging cervical constriction of tooth. Right: Maxillary and mandibular ridge contour for prosthetic support

The division of teeth with several roots, the relief of inter-radicular bone and similar simple precautions usually will prevent fractures of cortical plate, the maxillary tuberosities and the floor of the maxillary sinus. The abuses due to the use of blind and uncontrolled force through the expediencies of a "brawn and forceps" formula cannot be justified.

First, the surgeon should know the problem. Preoperative clinical and roentgenographic study dictates the degree of contouring of the alveolar process that is required in each instance. This should include "closed relation" examination with the remaining teeth in occlusion after a demonstration of the excursions of the mandible. The interference of pendulous tuberosities of the maxilla, gross disharmony between opposing alveolar ridges and variations in the vertical dimension are detected only when the jaws are examined in centric relation.

Good surgery is performed with full vision being afforded by adequate access. If it is apparent that the problems of tooth removal or alveolar irregularities will require bone relief or tooth sectioning, the generous reflection of mucoperiosteal flaps is indicated. Minor cortical irregularities and undercuts, as well as exostoses, are best eliminated with the teeth still in place. Often the heavy roll of cortical bone at the alveolar crest engages the cervical constriction of a root so as to make its removal difficult (Fig. 2, left). Rather than fracture this crest and the attached segments of cortical plate, it is logical to eliminate the crest prominence, which is also a potential undercut area. The removal of the associated teeth is thereby facilitated, and sacrifice of osseous structure is minimized.

All regions in which there are pathological conditions require investigation. The ravages of periodontal disease rarely leave a functional ridge contour. Such regions of bone loss should be exposed and investigated to eliminate irregularities.

The contouring should be carried out with regard to functional requirements. In the absence of unusual requirements, the ideal ridge contour is formed as a U-shape for maxillary and inverted U-shape for mandibular alveolar ridges (Fig. 2, right). Therefore, the level of both cortical plates should be equal, and the crest should present as broad and as flat a surface as possible. Instrumentation for alveolectomy is according to the choice of the operator, and sharp cutting edges are the fundamental requirement. Rongeur forceps, chisels, files and rotating cutting instruments can all be used

effectively. Hemostasis or the control of bleeding nutrient vessels in alveolar bone may be accomplished by direct pressure with a blunt instrument, since the mechanical crushing of trabecular bone obliterates the orifice and closes off the bleeding vessel. All sharp edges, protuberances, undercuts and pathological conditions should be carefully eliminated. Although the reflection of flaps on the lingual side should be minimal, the alveolar crest in this region deserves investigation. Razor-sharp crest edges and undercuts otherwise may be overlooked at the time of surgery. Later, when overlying soft tissues contract during the process of healing, the irregularities become obvious, prominent and troublesome.

In view of future prosthetic loads, efforts are directed toward the maintenance of the ridge width, which has equal or greater significance than the ridge height. With this goal in mind, the use of the intraseptal alveolotomy technic, which reduces ridge width (Fig. 3), may be questioned in spite of its conservation of cortical bone.

In following the principle of conservation, it may be possible to minimize cortical bone loss in the maxilla by eliminating only one side of a broad tuberosity undercut in bilateral situations. This will permit a path of insertion for the denture and also will lend added retention for it.

Many operators have the misconception that the soft tissues should be completely closed with linear approximation of the flap margin after alveolectomy. Attempts to achieve such a closure are unnecessary and may lead to a significant distortion of tissue. After the desired

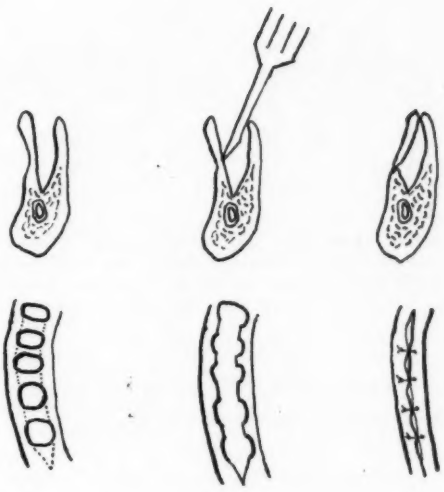


Fig. 3—Three stages of intraseptal alveolectomy as shown in cross-section and topographical views

osseous contour has been obtained, hemostasis has been established and thorough débridement has been carried out, the reflected flaps are gently manipulated over the ridge. At this time excess soft tissue may be detected and trimmed. Heavy submucosal fibrous pads in the tuberosity and retromolar regions may require thinning and reduction at this time. Care should be taken to place sutures over those regions of bone support; that is, the interseptal and inter-radicular bone ridges at the ridge crest. These initial sutures support the flaps without tension. If the labial and buccal mucoperiosteal flaps have been reflected to the base of the alveolar process, the suturing of the flap margins entails the hazard of reducing the sulcus depth and bringing muscle attachments toward the ridge crest (Fig. 4). Such a reduction in the mucobuccal fold of the vestibule is undesirable in view of the importance

Fig. 4—Flap closure after alveolectomy. Left: Alveolectomy completed. Center: Improper tight closure of mobilized flaps which will reduce depth of sulcus and move muscle attachments toward crest of ridge. Right: Proper approximation which returns the reflected flaps to place without distortion. Note that sutures should be over bone ridges and not over sockets

of allowing for adequate peripheral extension of the future prosthesis.

SECONDARY ALVEOLECTOMY—Indications for secondary alveolectomy after healing has taken place are usually specific and obvious. Sharp projections, razor-edged ridges and other irregularities occurring after alveolar atrophy are readily seen, usually palpable and often symptomatic. Occasionally a sharp-ridged crest may be camouflaged beneath an uncomfortable denture base by a submucosal fibrous hyperplastic mass. Roentgenographic examination and firm palpation will locate such offending areas. A complete roentgenographic survey of the alveolar ridges is a prerequisite to any secondary surgical intervention. Retained root fragments and a host of pathological entities may be beneath apparently normal tissues covering an alveolar ridge.

SPECIAL PROBLEMS — Disproportionate alveolar ridges—intermaxillary ridge disharmony—may be encountered in mouth preparations for dentures. Protrusion of the maxillary anterior ridge associated with extreme labioversion of the anterior teeth, extreme Class II malocclusion and relative mandibular micrognathia requires special planning. Careful evalua-

Fig. 5—Mylohyoid ridge reduction (similar to Caldwell's technic). Note that mattress sutures over bolsters from new sulcus to skin surface secure lingual ridge extension during initial healing. Left: Preoperative view. Right: Postoperative view

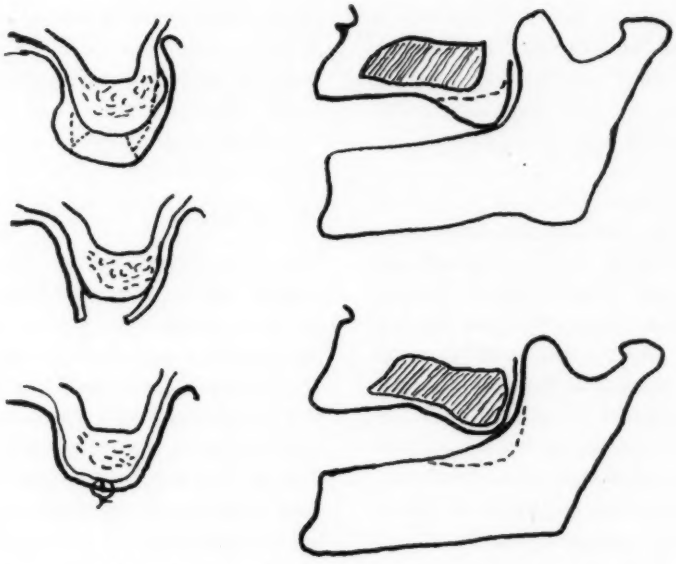


Fig. 6—Reduction of pendulous maxillary tuberosity. Left: Steps in reduction of fibrous pad and region of buccal osseous undercut. Right: Views showing limitation of tuberosity reduction imposed by alveolar extension of the maxillary sinus directing line of possible alveolectomy

tion of articulated study models, roentgenograms and a preoperative knowledge of the exact prosthetic requirements constitute the best guides to corrective surgery. Other problems may require similar planning. An extreme overbite with high upper lip attachments is associated with abnormal length of the maxillary alveolar process and requires reduction during the surgical preparation of the ridge. The anterior open-bite relation, with premature contact of posterior ridges, imposes another challenge to prosthetic balance which may be solved, at least in part, by carefully planned alveolectomy.

The sharp undercut contour of a posterior mylohyoid ridge may present an obstacle to adequate extension of the lingual periphery of a lower denture. Previous alveolar atrophy usually has contributed to such prominences. Although the subject of sulcus extension is beyond the intended scope of this paper, the common problem of the posterior mylohyoid region must be considered. Alteration of this condition by lingual ridge extension according to Caldwell's technic[4] is suggested (Fig. 5).

Reduction of the alveolar process in the tuberosity region is limited by the floor of the maxillary sinus. Often submucosal fibrous hyperplasia causes the bulk of these prominences, which may be contoured by excision and thinning of the flaps (Fig. 6, left). When there are defi-

4. Caldwell, J. B. Lingual ridge extension. J. Oral Surg. 13:287 Oct. 1955.

nite limitations to the reduction of a tuberosity and the intermaxillary relations still prevent space for coverage with a denture base, the opposing mandibular retromolar region may be reduced (Fig. 6, right).

RADICAL ALVEOLECTOMY—Excision of the alveolar process may be required for the elimination of neoplasms. Radical alveolectomy is also recommended when dental extractions are performed prior to high dosage irradiation for the treatment of oral malignancies. Since the dental root canal and the periodontal membrane provide avenues of access into vulnerable irradiated bone, with possible subsequent development of osteoradionecrosis, extraction of teeth and radical excision of the alveolus are indicated in the regions that will be subjected to significant irradiation. These procedures will simplify and accelerate healing of the oral soft tissues prior to irradiation.

■ *Summary*

The preparation of alveolar ridges follows simple principles based on prosthetic requirements and is within the philosophy of conservative treatment. Preoperative evaluation and careful planning are important. Rapid and complete healing and early stimulation by a balanced denture are significant objectives in the management of the alveolar process of edentulous jaws.

■ Power of Science

The instrument of scientific knowledge in our hands is growing more powerful every day. Indeed, it has reached the point when we can either set the world free from drudgery, fear, hunger and pestilence or obliterate life itself. . . . The people who control the scientific machine, both laymen and scientists, should have a proper understanding and appreciation of what science has grown into and its place among the great forces of the world. . . . It is clearly our duty as citizens to see that science is used for the benefit of mankind. For of what use is science if man does not survive?—*Prince Philip, Duke of Edinburgh, on his election to the presidency of the British Association for the Advancement of Science.*

Control of postoperative edema

■ *Edward C. Hinds, D.D.S., M.D., Houston, Texas*

Whereas the histology of the inflammatory response has been well outlined for many years, the biochemical mechanisms controlling these changes are still an unsolved problem in spite of many advances. Consequently, the management of postoperative edema must remain, at least in part, within the realm of empiricism. Swelling may develop in response to trauma anywhere in the body. In the facial region, however, it presents a particular problem because of its conspicuousness and because the tissues involved contain much loose areolar connective tissue and are prone to develop more edema than the tissues of other parts of the body.

■ *Process of Inflammation*

Boyd[1] states that inflammation is the most important as it is the most universal of all pathologic processes and the local reaction of the living tissues to an irritant. It follows that some degree of inflammatory change is present wherever tissues are subjected to the action of an irritant. No matter how aseptic an operation may be, it must inevitably be accompanied by some degree of inflammation. In essence, inflammation represents the body's efforts to localize and eliminate the irritating agent. Three phases are involved—the vascular changes, the formation of the inflammatory exudate and the process of repair. The vascular changes, as described by Cohnheim in 1877, involve dilatation of the arterioles with an increased and more rapid flow of arterial blood into the capillaries and venules, followed by a slowing down of the blood flow, producing a condition of stasis. The polymorphonuclear leukocytes become attached to the walls of the vessels, which now become increasingly permeable, allowing the leukocytes to pass through. Large amounts of plasma also pass through the vessel walls, and this plasma serves two functions: (1) it carries immunological weapons, such as agglutinins and gamma globulin to the scene of conflict, and (2) it also carries fibrinogen, from which fibrin is formed as the leukocytes and other cells release thrombin in the involved extravascular tissues. Fibrin limits the spread of infection and serves as the scaffold for the future process of repair.

Valy Menkin[2] has isolated a substance which he feels is the factor responsible for the vascular changes described. This substance is called leukotaxine, and, according to Menkin, it produces the increased permeability and draws the leukocytes to the region of injury. The earlier concept that this substance was very similar to or actually was histamine has been in a large part responsible for the enthusiasm for the use of antihistamines as anti-inflammatory

Bertner professor of surgery, the University of Texas Dental Branch.

1. Boyd, William. Pathology for the surgeon, ed. 7. Philadelphia, W. B. Saunders Co., 1955, p. 4-19.

2. Menkin, Valy. Biochemical mechanisms in inflammation, ed. 2. Springfield, Ill., Charles C Thomas, 1956, p. 3-58.

agents. For the most part, the inflammatory exudate is composed of plasma and polymorphonuclear leukocytes. The vascular changes and the inflammatory exudate are the basis of postoperative edema.

There are many factors which influence the degree of the inflammatory reaction, all of which are not well understood. The two outstanding factors are the amount of trauma and the presence or absence of infection. It also is recognized that there is an inherent, individual variation in the inflammatory response, other factors being equal. Excessive bleeding with the formation of a hematoma also contributes to the inflammatory response. It is self-evident, then, that inflammation is a necessary step to healing once a wound has been made. The degree of inflammation, however, varies considerably, and the question is how and to what extent the inflammatory reaction can be limited and its beneficial results still be obtained. It seems apparent that beyond a certain point all factors increasing the exudative reaction of the wound have a delaying effect on wound healing.

According to Christopher,[3] Whipple made the following statement on wound healing:

> The normal period of wound repair by first intention—three to four days of lag period followed by ten days of fibroplasia—cannot be improved or accelerated. The surgeon's constant effort should be to eliminate the factors which interfere with and prevent Nature's normal processes of wound healing. These are: tissue damage and failure to remove damaged or dead tissue, failure to maintain the blood supply to the wound borders and the adjacent tissues, failure to prevent the accumulation of blood clot and exudate in and between the wound surfaces, the introduction of heavy suture and ligature material which act as foreign bodies, and failure to maintain asepsis.

■ *Surgical Technic*

Probably the most important factor in the control of postoperative edema is surgical technic. Exodontia, or the surgical removal of teeth, constitutes a unique procedure in surgery, with problems peculiar to the region involved. The operative site itself is almost impossible to sterilize, although there seems to be an enhanced resistance on the part of the involved tissues to contamination from the oral field. There is an increased blood supply, and this certainly helps in the reduction of infection and at the same time also may be partially responsible for the tendency toward increased edema. The procedure involved in removing teeth is not comparable to any other surgical procedure. A certain amount of force is almost always required, and occasionally an excessive amount of force is exerted. Clot formation and second intention closure must be substituted for layer closures which are used in procedures involving other parts of the body. On the other hand, wound separation is ordinarily no problem.

Although the operative field cannot be sterilized, the operator's hands now can be prepared more effectively than ever before with the use of soaps and detergents containing hexachlorophene (G 11). Methods for sterilizing instruments and linen are at the present time most effective. As the result of the work of Semmelweis, Pasteur, Lister and others, aseptic technic has become a matter of rou-

3. Christopher, Fredrick. Textbook of surgery, ed. 6, Davis, Loyal, editor. Philadelphia, W. B. Saunders Co., 1956, p. 7.

tine. Meleney according to Christopher[4] reports that, in a hospital where careful records were kept, an incidence of postoperative wound infections of 5 to 20 per cent was noted. The meaning behind this is twofold: First, if all oral surgeons kept more accurate records, they would probably find that more postoperative wound infections occurred than they thought, and, second, there is still room for improvement in aseptic technics used.

Alling and Kerr[5] recently conducted an experiment demonstrating the effect of trauma on the incidence of dry sockets. This project might well provide the pattern for a similar study on the effect of trauma on the development of postoperative edema. Henri de Mondeville in the Middle Ages preached the gospel of careful surgical technic. In the modern era, William Halsted and his preceptor Kocher exploited the advantages of careful surgical technic. Careful technic means first of all a sincere respect for the tissues—sharp dissection where possible, rather than blunt, clean incisions, control of bleeding and careful retraction. Pulling, tugging and lacerating tissues are responsible for a goodly amount of postoperative edema. These are things that the surgeon does not learn overnight but that come only with constant practice and attention.

Surgical technic is particularly difficult within the oral cavity as is learned when the removal of an impacted lower third molar from a patient with an elongated dental arch is attempted. Severe postoperative edema is uncommon after simple extractions. Edema is more frequently a complication of multiple extractions and alveolectomies and, particularly, of extractions of impacted lower third molars. The decision as to elevation, sectioning with a chisel or sectioning with a drill is many times an individual matter. The more force is exerted on the bone and the supporting tissues, however, the more postoperative edema may be expected. For sectioning teeth, the chisel used must be very sharp. Nothing causes more trauma than attempting to section a tooth with a dull chisel. Sectioning teeth with the aid of a dental drill allows the removal of imbedded teeth and curved roots with minimum use of force. Débridement is an essential part of the technic in all types of surgery. Contused and congested gingival margins should be débrided, and spicules of bone should be removed. Sterile saline solution is used routinely at the University of Texas Dental Branch for irrigation of the field when much cutting of tooth or bone has been carried out. For many years drains were inserted in lower third molar sockets. More recently, all of these sockets have been closed primarily, where possible, with an increase in the incidence of primary healing and with no associated increase in morbidity.

Borgström and Sandblom[6] reported an experiment testing different types of sutures and suture technics on rabbits. They concluded that, if wounds were closed without tissue tension, there was no difference in wound healing irrespective of whether interrupted sutures or continuous sutures of different materials were

4. Christopher, Fredrick. Textbook of surgery, ed. 6, Davis, Loyal, editor. Philadelphia, W. B. Saunders Co., 1956, p. 42-44.

5. Alling, C. C., and Kerr, D. A. Trauma as a factor causing delayed repair of dental extraction sites. J. Oral Surg. 15:3 Jan. 1957.

6. Borgström, Stig, and Sandblom, Philip. Suture technic and wound healing. An investigation based on animal experiments. Ann. Surg. 144:982 Dec. 1956.

used. No difference was demonstrable when instances in which interrupted sutures and those in which continuous sutures were used were compared, nor was the rate of healing changed by the spacing of the sutures, by variant tightness of the sutures (within reasonable bounds) or by the use of plain forceps or of toothed forceps. The wounds with tissue tension showed lower tensile strength.

Continuous locked sutures are used for increased speed, and black suture is used because it is less irritating and less conducive to the development of postoperative infection than is catgut suture. Also, it has been found that it is easier to handle. Sutures can be removed on the fourth or fifth postoperative day without fear of wound separation. Drains may be inserted in instances in which there is danger of continued oozing. When inserted for this purpose, drains should be removed in 24 to 48 hours. It is preferable to control the bleeding surgically, when this is possible, and to close the wound primarily.

The pressure dressing probably is never used in exodontics. Pressure dressings have been advocated by surgeons for many years beginning with Blair[7] in 1924. They, however, have many drawbacks, and many of their advantages are questionable. Their main assets probably are control of bleeding and elimination of dead space. According to Pick[8] the question of dressings has by no means been settled. On the contrary, the subject deserves much more thought and further investigation. There is very little occasion to eliminate dead space in extractions. The use of gauze sponge in the immediate postoperative period, however, is probably a very valuable application of the pressure dressing technic, particularly for control of bleeding, which, incidentally, is most important in procedures in which large mucoperiosteal flaps have been raised, such as for the removal of bilateral torus mandibularis or torus palatinus. It is also of increased importance in the closure of oroantral fistulas.

The use of heat and cold to control postoperative edema remains to a great extent an empirical problem. Possoff[9] has recently attempted to evaluate the use of heat and cold during the postoperative period and has concluded that neither has any demonstrable effect on the rate of healing or the amount of swelling, though heat seems to have some value in the relief of discomfort. Theoretically, cold slows the metabolic response and diminishes the inflammatory reaction if applied early, whereas heat increases circulation, speeds up the inflammatory reaction and consequently aids in localization when it is applied after the inflammatory reaction is underway. This is the way it is used in the clinics of the University of Texas Dental Branch. Heat and cold, when used, are applied intermittently for periods of 20 minutes at a time.

■ *Use of Antibiotics*

Several papers have been written recently in regard to the use of antibiotics locally in tooth sockets after extractions.[10,11] Davis and co-workers[11] reported

7. Blair, V. P. Influence of mechanical pressure on wound healing. Illinois M. J. 46:249 Oct. 1924.

8. Pick, John F. Surgery of repair; principles, problems, procedures. Philadelphia, J. B. Lippincott Co., 1949, vol. 1, p. 170-172.

9. Possoff, Abraham. External thermal applications in postextraction therapy. J.A.D.A. 50:147 Feb. 1955.

on the removal of 3,000 lower molar teeth. A control group of 1,000 patients received no medication. A second group of 1,000 patients received sulfonamides (5 grains of sulfanilamide and 5 grains of sulfathiazole in cones) in the sockets of the teeth removed. Three cones were used in the larger third molar sockets. A third group of 1,000 patients were treated with cones containing 5 mg. of oxytetracycline. The results indicated a pronounced reduction of the number of instances of complicated healing in the group in which sulfonamides were used when compared with the group receiving no medication, and a still greater decrease in the number of complicated healing cases when oxytetracycline was used.

The subject, use of antibiotics, is a fertile field for debate. The oral surgeon might question if it is advisable to use small doses of antibiotics such as these for control of minor problems when it is well known that microorganisms can develop resistance to antibiotics. In certain instances there are side reactions. Some of the local drugs may act as foreign bodies, and, furthermore, the removal of the deeply imbedded lower third molar may involve trauma to a much larger region than the tooth socket itself. It is questionable whether antibiotics are indicated routinely. In instances in which they are indicated, perhaps, systemic administration may be preferable or, if a local antibiotic is to be used, irrigations with neomycin or bacitracin as suggested by Meleney[12] might be superior to sulfonamide or cones containing broad spectrum antibiotics.

According to Christopher,[8] Whipple stated:

> The use of the modern and recently discovered bacteriostatic and bacteriolytic antibiotics has revolutionized the treatment of medical and surgical localized and blood stream infections, but to depend upon the local instillation of these preparations and the shot gun doses of these antibiotics to replace careful aseptic and atraumatic wound repair is bad surgical practice.

Apropos to this subject, Dr. Henry Welch of the Antibiotic Division of the Food and Drug Administration has just announced that the number of severe reactions to penicillin has increased greatly and that indications for the use of this drug should be clear-cut.

■ *Use of Other Drugs*

Within the past ten years, due to an increased understanding regarding the mechanism of inflammation and the properties of certain drugs, some new approaches to the problem have been explored. Among the drugs are the antihistamines, hyaluronidase, intramuscularly given trypsin, streptokinase and adrenal cortical hormones.

ANTIHISTAMINES — Silverman[13] first reported favorably on the use of antihistamines in oral surgery in 1953. He admitted certain shortcomings in his investigative approach to the problem and urged that others examine the efficacy of this drug. All subsequent reports were favor-

10. Riddle, Arthur C., Jr. The clinical evaluation of oxytetracycline in oral pathology and oral surgery. In Antibiotics Annual 1954-1955. New York, Medical Encyclopedia, Inc., 1955, p. 924.

11. Davis, W. H., and others. Extraction wound healing: clinical observations. J. Oral Surg. 13:244 July 1955.

12. Meleney, F. L., and Johnson, B. A. Rational use of antibiotics in control of surgical infection. J.A.M.A. 153:1253 Dec. 5, 1953.

13. Silverman, R. E. Further clinical observations on the use of antihistamines in oral surgery. J. Oral Surg. 12:310 Oct. 1954.

able until one by Szmyd[14] in September 1956 and a more recent report by Keesling and myself.[15] In the latter study the double blind technic was used to eliminate subjective influences. In the two studies no improvement in healing was shown with the use of antihistamines. The original hypothesis was based on the idea that the activator of the vascular phenomenon in the inflammatory response was histamine, as suggested by Sir Thomas Lewis. There has been considerable evidence compiled in recent years to indicate that histamine is not the activator in inflammation due to trauma and infection, although it may play a more important part in allergic inflammation. It appears at the present time that the antihistamines have little real value in the control of postoperative inflammation.

ENZYMES—Howes[16] points out that many of the physiologic and pathologic processes that the surgeon attempts to correct by surgery are motivated by enzymes. Their role has become more apparent as the chemistry and physiology of the diseases the surgeon treats have been studied. A few examples are the disposition of fibrin and its solvation, the liquefaction of necrotic tissue, digestion and disturbance of it and the growth of tissues. With this background in mind, the surgeon has added enzymes from an external source to pathophysiologic processes in hope that their evolution might be brought about more rapidly and completely. By this method he has attempted to aid inflammation, thrombosis, the resolution of infection and healing. It is also interesting to note that two of the substances that may prove to be of some help in the control of inflammation are also a part of the armamentarium against pathogenic microbacteria—hyaluronidase and streptokinase.

According to Jasmin and Robert,[17] F. Duran-Reynals stated that chemically the ground substance of connective tissue consists of the polysaccharides—more or less loosely bound to proteins, chondroitin sulfate, heparin and, most important, hyaluronic acid. Physiologically, the ground substance has a definite state of permeability which is conditioned by different agents, of which hormones and spreading factors are the best known. The most active agents increasing permeability of the ground substance are spreading factors, notably hyaluronidase. The spreading reaction is the counterpart *in vivo* of the loss of viscosity *in vitro* of hyaluronic acid acted on by hyaluronidase. What used to be a barrier is now a conductor, and any material injected diffuses freely through the tissues and along the vessels of the host. Thus, there is a very lucid interpretation of what happens in edematous tissues when hyaluronidase is injected.

Duran-Reynals first noted this spreading factor in 1928 in extracts of rodent testes. In 1950, Lebensohn[18] reported the use of hyaluronidase in ocular surgery. In 1950, Cottle and co-workers[19] reported the use of hyaluronidase in rhinoplastic procedures. Benzer and Schaffer[20] first

14. Szmyd, Lucian. Clinical evaluation of an antihistaminic preparation in oral surgery. Oral Surg., Oral Med. & Oral Path. 9:928 Sept. 1956.

15. Keesling, G. R., and Hinds, E. C. Clinical evaluation of antihistamines in oral surgery using the double unknown technic. J. Oral Surg. 15:279 Oct. 1957.

16. Howes, Edward L. Use of enzymes in surgery. Surgic. Clin. N. America 36:497 April 1956.

17. Jasmin, G., and Robert, A. The mechanism of inflammation. Montreal, ACTA, Inc., 1953, p. 160-166.

18. Lebensohn, James E. Hyaluronidase in ocular surgery and therapy. Am. J. Ophth. 33:865 June 1950.

19. Cottle, Maurice H., and others. Hyaluronidase in rhinoplasty. Arch. Otolaryng. 52:369 Sept. 1950.

reported the use of hyaluronidase for the control of swelling associated with oral surgery. They proposed that the judicious use of the enzyme after a short period of normal postoperative healing would result in an enhanced diffusion of the fluid exudates away from the surgical site. Feeling that the use of hyaluronidase might be hazardous from the standpoint of interfering with the local immunity reaction if injected within the first 24 hours, they used the drug in connection with traumatic swellings after a period of time to allow localization of the process had elapsed. They reasoned that after the body undertakes to bring fluids into regions of inflammation for the purpose of protecting and healing, it sometimes does not have a mechanism for the judicious absorption of these fluids.

Clinical experience has shown that with persistent edema, fibrosis and induration may take place. Benzer and Schaffer used hyaluronidase in instances of disorders, such as injection hematoma, postoperative swelling after the reduction of facial fractures, ostectomies and the removal of impacted teeth, lymphedema after radical neck dissection and chronic trismus resulting from the presence of bullet shrapnel, as well as chronic trismus due to false ankylosis of the temporomandibular joint. They noted improvement, a decrease of the swelling, within a 30 to 60 minute period after the injection of hyaluronidase into the involved region. This was accompanied by alleviation of subjective symptoms such as tension, pressure and pain. No actual measurements were made, however. They were most impressed with the relief of injection hematomas and noted that the action of hyaluronidase in these instances was excellent. They also noted that when mild swellings were present, which clinical experience shows are resolving progressively, routine treatment is adequate. It is most important to note that Benzer and Schaffer injected from 150 to 500 turbidity reducing units into the involved regions and applied pressure by means of bandages or packings and hand massage after the injection.

Young and Kingsbury[21] and Fleuchaus[22] have reported clinical trials using hyaluronidase prophylactically for the control of postoperative edema and trismus after the removal of impacted third molars. Young and Kingsbury injected 150 turbidity reducing units into the anterior aspect of the masseter muscle near its attachment to the mandible. Fleuchaus combined hyaluronidase with the local anesthetic solution using on the average about 60 turbidity reducing units. Both groups used controls in the same patient by operating on one side with and on the other side without medication.

The report of Fleuchaus involved 19 patients and that of Young and Kingsbury 51 patients. Young and Kingsbury's criteria were largely subjective and no actual measurements were made, whereas Fleuchaus used calipers for measuring the thickness of the cheek and a millimeter rule for measuring the extent of the trismus. Both studies indicated less swelling and trismus in instances in which

20. Benzer, Paul, and Schaffer, A. B. Use of hyaluronidase in the treatment of traumatic swellings. Oral Surg., Oral Med. & Oral Path. 5:1315 Dec. 1952.

21. Young, H. E., and Kingsbury, B. C., Jr. Hyaluronidase for prevention of edema after removal of impacted mandibular third molars. J.A.D.A. 50:418 April 1955.

22. Fleuchaus, P. T. Effect of hyaluronidase on swelling and trismus after removal of impacted mandibular third molar teeth. Oral Surg., Oral Med. & Oral Path. 9:493 May 1956.

hyaluronidase was used, although Fleuchaus could measure the difference in millimeters but could not see the difference grossly. The difference in trismus was statistically significant only on the second and third postoperative days but not on the fourth and fifth. Fleuchaus also reported an equal incidence of dry sockets with or without the use of hyaluronidase.

A double blind test has not yet been reported with this drug, although such a project is being carried out at the University of Texas Dental Branch. The theory of the dispersion of fluids by hyaluronidase seems to have been adequately proved. Its application in oral surgery, however, needs further investigation. Several problems are apparent. One is the problem of proper dispersion of the solution. It appears that amounts up to 4 to 6 cc. must be injected into extensive edematous regions and possibly pressure maintained thereafter in order to achieve proper dispersion of the drug. At the same time it is puzzling how such good results can be obtained by prophylactic injections of small amounts of this drug with the local anesthetic prior to the removal of imbedded lower third molars.

In the clinics of the University of Texas Dental Branch, similar results have been noticed, including increased ecchymosis simultaneous with decreased swelling and trismus. During the past year one patient with hematoma of the floor of the mouth resulting from a dental drill accident was treated by the injection of hyaluronidase. Up to the time of the injection the swelling had been increasing, and within 30 to 45 minutes after the injection there was considerable regression of the developing hematoma. This use of hyaluronidase apparently was outstanding in the experience of Benzer and Schaffer.

It must be conjectured that either administration of the spreading factor allows the natural defenses to work more efficiently or it allows an invading pathogenic organism to grow more advantageously. Certainly, hyaluronidase must be contraindicated in the presence of obvious infection unless combined with an effective antibiotic.

Recently, several investigators[23-30] have reported the parenteral use of enzymes, particularly intramuscularly given trypsin and intramuscularly given streptokinase. The beneficial effect of intramuscularly given trypsin on the inflammatory process was first noted by Innerfield and co-workers[24] when they were attempting to study the lytic effects on the thrombi of thrombophlebitis. Since that time many favorable reports on the use of intramuscularly administered trypsin have been recorded. Miller and coworkers[28] were probably the first to use intramuscularly given streptokinase for the same purpose. The beneficial effect of intramuscularly given trypsin has been

23. Golden, Harold T. Effective treatment for traumatic and inflamed lesions using trypsin. Clin. Med. 2:583 June 1955.

24. Innerfield, I.; Angrist, A., and Schwarz, A. Parenteral administration of trypsin; clinical effect in 538 patients. J.A.M.A. 152:597 June 13, 1953.

25. Innerfield, Irving. The anti-inflammatory effect of parenterally administered proteases. Ann. New York Acad. Sc. 68:167 Aug. 30, 1957.

26. Kryle, Lawrence; Arnoldi, Charles, and Kupperman, Herbert S. The therapeutic effectiveness of trypsin in the treatment of thrombophlebitis. Ann. New York Acad. Sc. 68:178 Aug. 30, 1957.

27. Miller, Joseph M. The anti-inflammatory effect of intramuscular streptokinase. Ann. New York Acad. Sc. 68:185 Aug. 30, 1957.

28. Miller, J. M., and others. Clinical experience with the injection of streptokinase intramuscularly in the treatment of infection and edema. Maryland M. J. 4:188 April 1955.

29. Paul, S. J., and Naplicic, James. Use of trypsin intramuscularly as prophylactic measure to control inflammation following root resection. A preliminary report. Oral Surg., Oral Med. & Oral Path. 9:1015 Sept. 1956.

30. Schneider, Paul. Personal communication.

demonstrated experimentally in animals.[31] The exact mechanism for this effect is not understood; however, it is thought that these drugs activate a series of enzymatic reactions which serve to dissolve the fibrin clots.

Innerfield[25] stated:

> Regression of inflammation appears to be characterized by increased tissue permeability, by accelerated proteolysis, by depolymerized protein substrates—evidenced by decreased viscosity of protein-containing exudates—and by intravascular, intralymphatic and interstitial fibrinolysis.

Miller[27] stated:

> The mechanism of the action is at the present unknown and has not been proved by microscopic examination or chemical analyses. It is assumed that fibrin in edematous fluid is digested and that the viscosity of such fluid is reduced. The fibrin clots in local vascular and lymphatic circulations are dissolved and the edematous fluid is resorbed. The net result is an improvement in the local vascular and lymphatic systems.

Connell and Rousselot[32] conducted a study comparing the effectiveness of streptokinase, trypsin and cortisone on the inflammatory process. The results with streptokinase and trypsin were similar, although the incidence and severity of reaction were somewhat greater with streptokinase than with trypsin. In comparing these drugs with cortisone, Connell and Rousselot noted the following difference: Cortisone does not have any appreciable effect on hematoma or on suppurative wounds.

Miller also studied the effect of streptodornase and hyaluronidase, administered intramuscularly, and found that neither one of them had any beneficial effect on the inflammatory process. Golden[23] has used intramuscularly given trypsin *per se* effectively in the treatment of bacterial infection. Innerfield, however, contends that antibiotics should always be used with trypsin given intramuscularly in the treatment of bacterial inflammation. Miller feels that antibiotics should be used at all times when treating inflammatory reactions with intramuscularly given streptokinase. Paul and Naplicic[29] have published a report on the use of intramuscularly given trypsin as a prophylactic measure to control inflammation after root resection. Their study, however, does not include enough patients to be conclusive. Kryle and co-workers[26] have conducted a double blind study using intramuscularly given trypsin and have concluded that this drug was a potent therapeutic agent in the treatment of thrombophlebitis.

More recently a double blind study was conducted involving the use of intramuscularly given trypsin in oral surgery patients. The extent of swelling was measured by calipers across the masseter muscle. Trypsin was given in 5 mg. doses the night before surgery, the morning of surgery and the evening of surgery, and the fourth injection was given the following morning. They concluded that patients treated with trypsin had swelling about one third to one fourth the amount that the control patients had. The side effects associated with the use of intramuscularly given trypsin and streptokinase have been chiefly pain and erythema at the injection site, temperature elevation and urticaria.

31. Beiler, J. M.; Brendel, R., and Martin, G. J. Action of parenteral trypsin on experimentally-induced edemas of different types in rats. Proc. Soc. Exper. Biol. & Med. 89:274 June 1955.

32. Connell, James F., Jr., and Rousselot, Louis M. The evaluation of anti-inflammatory drugs in surgical lesions. Ann. New York Acad. Sc. 68:155 Aug. 30, 1957.

Howes[16] cautions that enzymes are proteins and that, therefore, the characteristic difficulties found with the clinical use of proteins are encountered. First they can be allergenic if the patient has a sensitivity. Next, antibodies to them can be produced—antibodies that neutralize their action. This neutralization would occur only if enzymes are used for too long a period of time. The action of enzymes is so powerful that if a desired result is not obtained in the first four or five days, very little is going to be accomplished thereafter.

It seems apparent that these drugs can be beneficial; however, it is hoped that much more will be learned about the mechanism of their action in the future. I believe at the present time that the use of these drugs is not indicated as a routine measure in oral surgery because of the inconvenience and side effects reported. They may be of value in instances in which severe inflammatory reactions have occurred and are anticipated because of extensive surgery.

ADRENAL CORTICAL STEROIDS—A discussion of the control of inflammation would not be complete without some mention of adrenal cortical steroids. In 1940, Menkin[33] first demonstrated that adrenal cortex extract suppresses the action of an exudate or of its contained leukotaxine in increasing capillary permeability. These observations were the first demonstration of the anti-inflammatory action of adrenal cortex extract. H. Kendall and associates reported on the effectiveness of cortisone and corticotropin in arthritis in 1949. Cortisone should probably be considered a true anti-inflammatory agent, whereas it seems that the intramuscularly given proteases aid and abet the inflammatory process. Cortisone is thought to act at a cellular level (in distinction to molecular, enzymatic or other levels) and to act in a general way to suppress the entire inflammatory reaction, including wound repair. Because of the danger of spread of infection, delayed repair, adrenal suppression and altered metabolic processes, such as retention of sodium, it does not seem advisable to use adrenal cortical steroids as an adjunct for the control of traumatic inflammation. Cortisone has had its greatest use in the treatment of rheumatoid arthritis, ophthalmic inflammations and allergic reactions. The enthusiasm for cortisone in the treatment of rheumatoid arthritis, however, has recently diminished because of the establishment of cortisone dependency and a tendency for the beneficial effect to wear out after a period of time.[34]

■ *Summary*

It can be concluded that none of the newer agents mentioned are a substitute for careful surgical technic and judgment. The antihistamines appear to be of little or no value. Cortisone in most instances probably is contradindicated. Further studies need to be undertaken in regard to hyaluronidase and particularly in regard to method of administration. This drug certainly, in contrast to some of the others, is associated with minimal side effects and toxicity. It appears that intramuscularly given proteases may be of definite benefit in certain instances, and the study of their mechanism has contributed to the understanding of the inflammatory process.

33. Menkin, Valy. Biochemical mechanisms in inflammation, ed. 2. Springfield, Ill., Charles C Thomas, 1956, p. 343-345.
34. Yow, Ellerd. Personal communication.

Antibiotics in oral surgery: a review

■ *Marvin Revzin, M.S., D.D.S., Detroit*

Félix Martí-Ibáñez[1] has stated:

> The enormous importance of antibiotic therapy in the present-day clinical case of an infectious patient indicates that a new branch of medicine has been created: antibiotic science. Antibiotic medicine has grown at such a rate that it already represents a doctrinal corpus of considerable scientific importance. . . . The next half century will probably reveal a double tendency in the field of antibiotic therapy: along with new broad-spectrum antibiotics capable of destroying almost any type of enemy bacteria, other antibiotics will be developed capable of reaching the most difficult target and having such specific and limited effect that they will destroy a single germ. We shall boast of chemical atom bombs and magic biochemical arrows! . . . Also antibiotic therapy in the next half century will aim at more prophylactic and less therapeutic ends. It will become more preventive and less curative.

It would be well to evaluate the current status of the use of antibiotics in oral surgery by reviewing some pertinent general principles.

Ehrlich, who some call the father of modern chemotherapy, stated the following postulates in regard to the use of drugs to combat disease:

1. Drugs which have a selective and a direct action on parasites can be found.
2. Strains of parasites which are resistant to each drug could be developed.
3. Two or more independently acting drugs could be more effective and could provide less emergence of drug resistance.

These principles appear to be the basis on which the use of antibiotics is founded, and they forecast such interesting phenomena as bacterial resistance and cross resistance to antimicrobials and the terms "synergism" and "antagonism." These latter have been the subject of a great deal of experimental and clinical investigation. As a result, the professional literature on the subject is voluminous and the research still has not been completed.

The use of antibiotics in combating infections in oral surgery is still founded on empirical as well as rational grounds. Rules and reason for the use of these drugs demand an identification of the microorganism which is causing the infection before instituting therapy. The proper choice of an antibiotic is based on the laboratory-tested sensitivity of the bacteria to the drug; then the necessary dosage of the antibiotic should be employed for a sufficient time to accomplish its purpose. A knowledge of synergism and antagonism must be applied when it becomes necessary or advisable to use drugs in combination, and an appreciation of the fact that "antibiotic-resistant" organisms are appearing is mandatory. However, experience has shown many oral surgeons that antibiotics are used empirically.

Associate oral surgeon, Henry Ford Hospital.

1. Martí-Ibáñez, Félix. In Antibiotics Annual, 1955-1956. New York, Medical Encyclopedia, Inc., 1956.

Often they are used when the clinical signs and symptoms of infection are present and before a culture is obtained to identify the organism and to subject it to antimicrobial sensitivity tests. The results of these practices are often efficacious but carry with them the threat of sensitizing the patient to future therapy or of enhancing the chances for the emergence of resistant strains of bacteria. In spite of these threats, the use of antibiotics is based on the urgency of the disease, the site of the infection, the physical condition of the patient, the probable duration of the illness and treatment with and without the use of the drugs and the probable mechanical-physiological complications, such as the spread of an upper face infection to the cavernous sinus.

The prediction of Dr. Martí-Ibáñez that antibiotics will be used more to prevent illness than to cure it has in a sense come true. In the face of disease concomitant with an oral surgical problem, the oral surgeon is already in the habit of using antimicrobials for prevention. He finds it necessary to use these drugs when treating a patient with rheumatic heart disease, renal disease, or diabetes mellitus.

■ *Bacteria and Antibiotics*

The streptococci and the staphylococci are most apt to be the causative agents in infections arising from the oral cavity. The alpha streptococci are commonly designated *Streptococcus viridans* and are associated with infections which are insidious and progress slowly.

It is estimated that 90 per cent of all cases of subacute bacterial endocarditis are due to this strain. The beta hemolytic streptococci are the more virulent strains and infections of this group are characterized by a sudden severe onset, often accompanied by a profound toxemia.[2]

The beta group is further classified according to Lancefield into 12 serologic groups, the most important of which, as far as human beings are concerned, is group A.

Present evidence is in favor of the principle that rheumatic fever is related to infection with beta hemolytic streptococci, and that the prevention or rapid cure of these infections when they do occur will prevent most attacks of rheumatic fever.[3]

The commonest organisms responsible for suppurative infections of the skin and bones are the staphylococci, and the majority of strains from human infections are *Staphylococcus pyogenes* var. *aureus*, followed by *Staph. pyogenes* var. *albus* and *Staph. citreus*. Whenever the staphylococci are the causative organisms, there is a tendency to abscess formation and tissue destruction. These infections usually are localized but may invade the blood stream and become generalized.

Staphylococcal infections are common in patients with diabetes mellitus, and the prognosis may be decidedly worse when the two conditions coexist. It is therefore important that the presence of diabetes be ruled out in staphylococcic infection.[4]

The other bacteria found which may be pathogenic and of importance to the oral surgeon are the pneumococci, the *Corynebacterium diphtheriae* and the

2. Welch, H. Antibiotic therapy. New York, Medical Encyclopedia, Inc., 1954, p. 304.
3. Welch, H. Antibiotic therapy. New York, Medical Encyclopedia, Inc., 1954, p. 312.
4. Welch, H. Antibiotic therapy. New York, Medical Encyclopedia, Inc., 1954, p. 324.

Vincent's organisms, spirochetes and fusiform bacilli.

The antibiotics are conveniently divided into two groups:

Group 1, consisting of penicillin, streptomycin, bacitracin and neomycin.

Group 2, consisting of the broad-spectrum antibiotics such as chlortetracycline, oxytetracycline, chloramphenicol and tetracycline.

The drugs in Group 1 are chiefly bactericidal and are most effective against rapidly multiplying bacteria. Those drugs in Group 2 are principally bacteriostatic in action.

The relationship of each drug within its own group and with drugs in the other group was the object of a study conducted by Jawetz and others and was reviewed in a recent article in this journal.[5] The question was asked what the antimicrobial effect would be when certain of these drugs were administered together. The answer seems to be one of four possibilities. The effect may be: (1) indifferent; (2) additive; (3) synergistic, or (4) antagonistic.

Drugs in Group 1 are frequently synergistic with each other, are occasionally indifferent but are never antagonistic to each other. Members of Group 2 are neither synergistic with nor antagonistic to each other but may show simple additive effects. When drugs of Group 1 are used with those of Group 2, the effects may be extremely complex and depend on the susceptibility of the microorganism. Thus it may be seen that the common combination of penicillin and streptomycin, both members of Group 1, have a real usefulness in combating certain infections. In instances in which the bacteria prove to be resistant to penicillin, a Group 2 antibiotic, one of the so-called broad-spectrum drugs, should be used, but generally not in combination with penicillin. Again it should be emphasized that the choice of the antibiotic should be based on the laboratory identification of the organisms and a report of the sensitivity to the various drugs.

The use of combined antimicrobial drugs grew out of a need to find agents which would control infections brought about by organisms which were resistant to the antibiotics employed or those which failed to respond clinically to the drugs which were used. It became evident that the bacteria might be developing resistant strains. This was noted with the use of the sulfonamides and then with the use of penicillin, and finally it became apparent that the bacteria were becoming resistant to the broad-spectrum antibiotics also. Cross resistance has added a further complication. This occurs when bacteria which are made resistant to a specific antibiotic develop properties which make them resistant to other antibiotics. A review of this subject has appeared in the *Journal of Oral Surgery*.[6]

An unusual aspect of resistant bacteria is worthy of note and should be of special interest to those who practice in hospitals. This has to deal with staphylococcus bacteria in the hospital environment. These organisms present in the hospital have become increasingly more resistant and have threatened a serious hospital epidemic. Although there is no

5. Small, I. A. Antibiotic synergism and antagonism: review of the literature. J. Oral Surg. 13:324 Oct. 1955.

6. Small I. A. Bacterial resistance and cross resistance to antibiotics. J. Oral Surg. 14:129 April 1956.

known epidemic at present, reports from various hospitals throughout the country indicate that proper precautions are to be taken to prevent such a serious situation from occurring. Suggested precautions include:

1. The avoidance of the routine preventive use of antibiotics.
2. The use of a careful aseptic technic with all injections and instrumental procedures, either diagnostic or therapeutic.
3. The careful application of principles of asepsis and antisepsis in all surgical procedures.
4. Care to avoid speaking over an open wound without adequate masks.
5. The isolation of all patients with open infections due to resistant bacteria, either by isolating the patient or more properly by isolating the wound with dressings.
6. The use of a mask at all times when in contact with patients with open infections.
7. The use of sterile gloves when changing dressings on such patients and the disposing of soiled dressings in bags set aside for this purpose.
8. The frequent washing of the hands.
9. The suggestion that doctors and nurses with boils or carbuncles should not scrub for surgery nor should they change dressings.

The staphylococcal infections which are penicillin resistant may be caused by hospital personnel acting as carriers. Barber and co-workers[7] discovered that 75 per cent of the staff of a hospital with a relatively high incidence of infection due to penicillin-resistant staphylococci carried coagulase-positive staphylococci, and 83 per cent of these carried penicillin-resistant strains. Other investigators have reported similar observations.

A brief description of the antibiotics most effective and most commonly used in the field of oral surgery will serve as a review of the drugs now available. It must be kept in mind, however, that the entire field of antibiotic therapy is in a constant state of discovery and development.

■ *Penicillin*

Penicillin, because of its action against the organisms most commonly found to cause infections which oral surgeons are called on to treat, namely, the gram-positive streptococci and staphylococci, is still the most widely used and most efficacious antibiotic in use today.

It is primarily a bactericidal agent but has some bacteriostatic properties. It is classified in Group 1 in regard to synergism and antagonism. The form, mode of administration and dosage schedules of penicillin have undergone many changes. Today the most important forms are:

1. Procaine penicillin G, which is a stable crystalline salt (amorphous penicillin is no longer manufactured). This is available either as a sterile powder to be mixed with 1.2 cc. of an aqueous diluent to supply one dose of 300,000 units per injection, or in an aqueous suspension which makes it ready for injection where each 1 cc. contains 300,000 units. This form will maintain a low blood level for about two days after a single intramuscular injection.

7. Barber, M., Hayboe, F. G. J., and Whitehead, J. E. M. Penicillin-resistant staphylococcal infection in a maternity hospital. Lancet 2:1120 Dec. 17, 1949.

2. Procaine penicillin G, 300,000 units, fortified with a crystalline sodium or potassium penicillin of 100,000 units in either the powder to be mixed or the aqueous suspension. Each cubic centimeter will supply 400,000 units to reach a high tissue concentration in about 30 minutes and to maintain the level of the regular 300,000 units of procaine penicillin G at a low concentration for about two days.

3. Procaine penicillin in oil with aluminum monostearate is a preparation designed for intramuscular use which will maintain an effective blood level for about 72 hours.

4. Benzathine penicillin G is a repository drug which maintains a level effective for prevention for approximately ten days to two weeks. When it is given in combination with 300,000 units of procaine penicillin G, a relatively high blood level is reached quickly and lasts for 24 hours, and the low-level repository action continues for ten days to two weeks. This form of penicillin has been used widely in treating rheumatic fever patients preventively.

5. Oral penicillin is found as potassium penicillin G (200,000 unit tablets), the oral benzathine penicillin G in either a 200,000 unit tablet or in a suspension which contains 300,000 units per 5 ml., and penicillin V (phenoxymethyl penicillin). The oral dosage has been estimated to be between three to five times the intramuscular dose in order to reach equal blood level concentrations. This is due mainly to the breakdown of the penicillin G in the digestive tract and thus its loss without absorption. Penicillin V, however, has a unique stability in acid solutions and hence during digestion. Studies[8] have shown that the blood levels after the oral administration of penicillin V are higher than those after penicillin G.

■ *Streptomycin and Dihydrostreptomycin*

Streptomycin and dihydrostreptomycin are similar in action and are generally considered together. They are active against gram-positive and gram-negative organisms and, like penicillin, belong to Group 1. Although these drugs are active against gram-negative organisms, their use for this purpose has not been extensive of late because of the use of the broad-spectrum antibiotics. The major use of streptomycin-dihydrostreptomycin has been in the treatment of tuberculosis. A combination of procaine penicillin G plus 0.25 Gm. each of streptomycin and dihydrostreptomycin in a single intramuscular injection has proved to be a good means of combating an infection which might be due to a gram-negative as well as a gram-positive organism. Because both penicillin and these two drugs are classified as Group 1 antibiotics, they work well together.

■ *Erythromycin*

Welch[9] stated that the activity of erythromycin against gram-positive organisms places it on a par with penicillin. It is also somewhat effective against the gram-negative organisms, certain of the large viruses and rickettsiae. Thus it is placed in the so-called broad-spectrum

8. Cox., F., Jr., and others. Further observations on the use of large doses of oral penicillin V (phenoxymethyl penicillin). In Antibiotics annual, 1956-1957. New York, Medical Encyclopedia, Inc., 1957, p. 282-286.

9. Welch, H. Antibiotic therapy. New York, Medical Encyclopedia, Inc., 1954, p. 170.

group of antibiotics. It is of value for use in those patients who give a history of reaction to penicillin. The usual daily dose for adults is 2 Gm. divided into 0.5 Gm. every six hours.

■ *Chlortetracycline, Oxytetracycline and Tetracycline*

The broad-spectrum antimicrobials chlortetracycline, oxytetracycline and tetracycline are similar in chemical structure and therapeutic application. They are most useful for oral administration and are effective against both gram-positive and gram-negative bacteria. The dosage schedule for each of these drugs is similar in that the average dose for adults is from 1 to 2 Gm. daily divided into 250 to 500 mg. portions four times per day. These drugs are classified as Group 2 agents. They, therefore, are considered antagonistic to penicillin, thus excluding their simultaneous administration.

■ *Chloramphenicol*

Chloramphenicol received a good deal of unfavorable notice when several studies revealed that blood dyscrasias, notably the usually fatal aplastic anemias, followed its prolonged and excessive use. However, when its use is indicated and when the total dose for adults does not exceed 26 Gm. over a ten day period, it has proved to be an extremely important drug in the fight against infection. Its indiscriminate use is still to be avoided. It is the drug of choice in the treatment of typhoid fever. It is truly a broad-spectrum antibiotic, having an activity against both gram-positive and gram-negative bacteria, as well as certain rickettsiae, spirochetes and viruses.

■ *Unfavorable Side Reactions*

All the antibiotics currently available have some adverse side reactions which range from a mild unpleasantness to a serious and sometimes fatal consequence. Fortunately the benefits to be derived from their intelligent and judicious use far outweigh and outnumber the untoward reactions.

Each of the specific antibiotics may have its own undesired reactions, although many of them share to a degree a common set of sequelae which detract from their perfection. The broad spectrum antibiotics oxytetracycline, chlortetracycline and tetracycline have all produced gastrointestinal upsets such as nausea, vomiting and diarrhea, and the first two have been blamed for causing fatal staphylococcal enterotoxemia due to a resistant gram-positive coccus. Nausea, vomiting and diarrhea may be reduced by administering these drugs after meals or with milk. If vomiting and a profuse watery diarrhea persist, the drug should be discontinued immediately.

Chloramphenicol has produced agranulocytosis when given in excessive doses for prolonged periods, particularly in children. It has also been accused of producing fatal instances of aplastic anemia in children. Its administration should be accompanied by weekly blood counts.

Streptomycin, given for prolonged periods, has produced vestibular damage and deafness; yet its usefulness against certain enterococci remains important.

Penicillin does not share with the broad-spectrum antibiotics the adverse gastrointestinal effects but has certain undesirable effects of its own. The most

serious effect is the anaphylactic reaction which could terminate fatally. This occurs most frequently after the intramuscular injection of penicillin, frequently to a patient with asthma who has had penicillin previously. Immediate therapy which consists of the subcutaneous injection of 0.5 cc. of epinephrine (1:1,000) may be life saving.

Anaphylactoid reactions may be recognized by a sudden onset of spasms, coughing, a sudden precipitous drop in blood pressure and a weak, thready pulse. Although these severe reactions may occur after oral or topical use of penicillin, they are much more frequent after parenteral use. Less severe but still annoying to the patient is the appearance of urticaria, pruritis, edema or headache and sore throat. These are best treated by stopping the use of the penicillin and instituting antihistamine therapy. If the symptoms are severe, the steroids may be used. For the skin lesions, a calamine lotion may help make the patient more comfortable. These serum reactions may be delayed in onset by as much as several weeks after the administration of penicillin to the patient.

Penicillin shares with all the antibiotics the ability to suppress the normal flora of the gastrointestinal tract thus permitting the growth of monilial infections. An antifungal antibiotic, nystatin, is now available to help combat the emergence of the gastrointestinal moniliasis. The development of highly effective oral penicillin forms, namely penicillin V and, most recently, a penicillin V potassium which will insure a rapid blood titre and one which will have an effective maintenance level, argues most strongly for a switch from a parenteral to an oral administration of this antibiotic.

■ *Preventive Use of Antibiotics*

In the introduction to this paper, a prophecy was made that the future would see a greater employment of antimicrobials as a preventive rather than as a therapeutic measure. In a manner this is now true. The oral surgeon uses antibiotics preventively with patients who are on prolonged steroid therapy because of their lessened ability to resist infection. Diabetes is often first detected when a patient has a fulminating staphylococcal infection, and he is treated with antibiotics before surgery because of his lowered resistance to infection and his lowered reparative powers. But it is the patient who has had rheumatic fever or who has a congenital heart defect who benefits most by the administration of antibiotics prior to surgery. The American Heart Association[10] has stated:

> Penicillin is the drug of choice for administration to patients with rheumatic or congenital heart disease undergoing dental manipulations or surgical procedures in the oral cavity . . . . there is some evidence that for effective therapeutic prophylaxis reasonably high concentrations of penicillin must be present at the time of the surgical procedure. The dosage regimens employed for long-term prophylaxis of rheumatic fever are inadequate for this purpose. . . . Dosage—Six hundred thousand (600,000) units of aqueous penicillin and 600,000 units of procaine penicillin in oil containing 2 per cent aluminum monostearate administered intramuscularly 30 minutes before the surgical procedure. As an alternative . . . penicillin may be administered by the oral route

10. American Heart Association. Prevention of rheumatic fever and bacterial endocarditis through control of streptococcal infections. Circulation 11:17 Feb. 1955.

in dosages of 250,000 to 500,000 units one-half hour before each meal and at bedtime beginning 24 hours prior to the operation and continuing for five days. At the time of the surgical procedure it is advisable to give an additional 250,000 units.

Since these recommendations were published, Quinn and others[11] reported the successful use of oral penicillin V in the treatment of subacute bacterial endocarditis. This may prove to be the route of choice when using penicillin for prevention in patients with rheumatic or congenital heart disease.

■ *Summary*

The entire field of antimicrobial therapy is a constantly expanding one and one which demands that the oral surgeon be constantly alert for new developments in this aspect of the fight against infection. Antibiotics as they are used today constitute two broad groups. Group 1 contains the most often indicated and used penicillin and Group 2 contains the so-called broad-spectrum antibiotics. Untoward reactions and the treatment of undesirable sequelae should be important to all oral surgeons who employ antibiotics.

In the final analysis the use of antibiotics is based on experience and the clinical picture of the patient, but it is most effective when the organism has been demonstrated and when a laboratory has run the proper sensitivity tests to indicate the antibiotic of choice. The intelligent and judicious employment of antimicrobials will prove to be an extremely valuable instrument in the armamentarium of all who are involved in the fight against infection. — *16559 Wisconsin Street.*

11. Quinn, E. L., and others. Oral phenoxymethyl penicillin (penicillin V) in the treatment of subacute bacterial endocarditis. In Antibiotics annual, 1955-1956. New York, Medical Encyclopedia, Inc., 1956, p. 502-505.

Control of postoperative pain

■ *Edward C. Thompson, D.D.S., and Charles R. Morris, D.D.S., Urbana, Ill.*

Recently there has been a great deal of advertising and discussion of combinations of drugs for the control of postsurgical pain, and the present situation recalls the era of the "shotgun prescription." The advent of the so-called tranquilizing drugs has been an additional factor in the general scene. However, prevention of pain by means of expertness of surgical technic is, of course, the ideal remedy. Each procedure, regardless of how simple, must be planned with the idea in mind that it might become a complicated one. The scope of this paper will be limited to con-

Department of oral surgery, Carle Hospital Clinic.

sideration of the postoperative problems associated with the removal of teeth and attendant surgery, but the subject cannot be dealt with adequately without mention of the fact that the surgeon must have a sound concept of the methods of preparing flaps and of properly contouring the alveolar ridge and he must have respect for tissues.

Probably the most common cause of pain after the removal of a single tooth is failure to reduce or readjust the alveolar margins and secure the soft tissue by means of one or more properly placed sutures. It is significant that few patients who have undergone removal of a number of teeth with extensive alveoloplasty suffer severe pain. Astute surgical care of the socket walls usually assures clot retention, and, if these technics are carefully carried out, the management of postoperative pain is then primarily a matter of providing the required dosages of selected analgesic drugs.

Variations in the pain threshold are related to personality and, most certainly, also to physiological factors. In dealing with the patient, the surgeon must express confidence through his manner and actions. It is important to prevent psychic trauma, which may alter the patient's response during the postsurgical period. The patient who is tense, apprehensive, vitamin deficient, debilitated or poorly nourished or who is an alcoholic can be expected to suffer pain postoperatively, and, if these warning signs are heeded, the necessary steps can be taken. Such a patient may need premedication or dietary reinforcement. The diet in the immediate postoperative period is of particular importance, since hunger is often the major culprit in causing pain. It is also likely that the patient particularly may avoid proteins, and, of course, protein is a most necessary postsurgical food.

To manage the psychic, dietary and therapeutic care of the postoperative patient properly, lucid and brief printed postoperative instructions should always be given to the patient or his family. When the patient or his family is poorly instructed, not knowing what to anticipate or what to do, the patient will frequently become apprehensive and tense, and his pain threshold thus will be lowered owing to this anxiety state. If the dentist has fulfilled the requirements of good management that have been described, he can devote his attention to the selection of the proper medicaments to make the patient's postoperative course as tolerable as possible.

■ *Routinely Administered Postoperative Medicaments*

The majority of patients undergoing oral surgery are ambulatory, and they desire to carry on their normal activities as nearly as possible. The selection of medication for relief of pain should be based on this fact.

The probable severity of postoperative pain usually governs the choice of the required analgesic and the suitable adjuvants. The uncomplicated removal of a single permanent or deciduous tooth may cause so little discomfort that relief can be obtained by the administration of 5 or 10 grains of aspirin. In those instances in which the procedure is of slightly greater severity and in which minor surgical trauma has been inflicted, for example, the reflection of a gingival flap for

access to the root of a maxillary bicuspid, aspirin or mixtures containing aspirin, such as that with phenacetin and caffeine, are quite effective.

More complicated operations in which flaps are necessary for the removal from dense bone of ankylosed teeth or those with widely spread roots require the use of narcotic drugs, especially in those instances in which the alveolus has been much abused. A mucoperiosteal flap prepared with a well-defined incision through the periosteum and down to the bone at a point well removed from the intended alveolectomy will heal uneventfully when it is properly closed. Lacerated soft tissue or heavily traumatized, rough alveolar bone inevitably causes pain and slow healing. Good judgment as to the extent of such flaps is an asset, of course, as extremely large flaps produce greater ecchymosis and edema. When the patient is well managed, aspirin, phenacetin and caffeine with ½ or 1 grain of codeine is usually adequate for pain control.

In those patients who fail to respond completely, an additional ½ grain of codeine may be prescribed without doubling the dose of the aspirin mixture, and, thus, added gastric irritation may be avoided. Over a period of many years, this prescription has proved to be more satisfactory than others. It should be noted that no hypnotic or drug to induce euphoria is included, nor is it desirable to include or prescribe routinely any of the so-called tranquilizers. Even for more severe operations, such as the removal of impacted teeth and extensive alveoplasties, it is desirable to avoid the production of stupor. Relaxation of the patient's tension by actual production of analgesia is ideal. If this is achieved, the patient will be able to eat a nearly normal diet and avoid hunger, fatigue and the associated increase of pain.

Provided psychic rapport between the oral surgeon and the patient has been established through good preoperative and operative management, this method of pain control meets the requirements of the vast majority of oral surgical procedures. There is really no need for the use of barbiturates, atropine, scopolamine (Hyoscine) or other alkaloids. Combinations of such drugs are often useful for the control of pain associated with other conditions, but they have no place in the routine postoperative care of the dental patient. The average patient who is receiving proprietary medicines made up of a combination of these drugs will be intoxicated and euphoric and will dislike the experience.

An honest realization by the surgeon of his surgical limitations will prevent needless surgical and psychic trauma, and procedures that are too complicated for him should not be attempted by the surgeon for a variety of reasons, not the least of which is that there is almost automatic communication of the surgeon's anxiety to the patient.

■ *Local Applications of Medicines and the Dry Socket*

A traumatized, burnished alveolus results in a dry socket after sloughing of the blood clot,[1] and this condition may be treated best by judicious lavage and the placing of an analgesic paste or dressing

1. Alling, C. C., and Kerr, D. A. Trauma as a factor in delayed repair of dental extraction sites. J.O.S. 15:3 Jan 1957.

within the surgical defect. There is no need for extensive curettage. Cautious débridement is all that is necessary. Forceful packing of the socket should be avoided to allow peripheral granulation tissue to develop normally. If a gauze dressing is used, it should be applied gently and, as a rule, should be changed the next day if pain is severe. Improvement usually permits discontinuance of the use of a gauze dressing within three to four days, and the pain then may be controlled adequately by the use of analgesic pastes or by oral medication. Such a gauze dressing should incorporate a favored medication, such as a chlorobutanol preparation (Dentalone) or an anodyne paste, several of which are listed in *Accepted Dental Remedies*.

At this juncture, a decision must be made as to the desirability of concurrent antibiotic therapy. Also, of great importance is the patient's nervous and physiological state. He may require only reassurance and a little additional medication with codeine or antibiotic therapy, nutritional supplementation or, in extreme cases, intravenous infusion or injection of glucose with vitamins. This may be accomplished by infusing 500 to 1,000 cc. of 5 per cent glucose to which certain B vitamins have been added (Beclysyl, Abbott Laboratories), which also serves the purpose of allaying hunger and re-establishing electrolyte balance. There also are preparations available which may be injected slowly, either intravenously or intramuscularly, by means of a syringe (Berocca-C, Hoffmann-La Roche, Inc.).

The approach to the control of severe postoperative pain may be influenced by the presence or absence of nausea.[2] If the patient is nauseated, the combined use of codeine, a barbiturate and alkaloids may be indicated. Cyclizine hydrochloride (Marezine Hydrochloride, Burroughs Wellcome & Co.) is also excellent.

Extensive study should be devoted to the physiological effects of these and similar drugs before administering them. If consultation is needed, the general surgeon or obstetrician most often will have a reliable concept of their effectiveness.

One of the simplest means of controlling severe pain in a nauseated patient is by means of rectal suppositories containing ¼ grain of belladonna extract and 1 grain of powdered opium. This preparation is supplied by Wyeth, Inc., in a capsule, and, when the patient also drinks one ounce of sparkling water hourly, relief is usually prompt. Tea, soup, or other such foods may then be taken, and oral feeding and medication may be resumed. Intramuscular injection of morphine, meperidine (Demerol) hydrochloride and other sedatives with atropine may also be very effective. These should not be used any longer than necessary for obvious reasons.

■ *Ecchymosis and Edema*

A discolored, swollen jaw may cause a patient's family undue concern, and, whereas confident reassurance is usually all that is necessary, it is a fact that pain and edema are of more concern in oral surgical procedures than in many other types of surgery. It is almost impossible to immobilize the tissues or place a pressure dressing on the wound. Therefore, it

2. Best, Charles Herbert, and Taylor, Norman Burke. The physiological basis of medical practice; a text in applied physiology, ed. 5. Baltimore, Williams & Wilkins, 1950.

appears that only skilled surgery and the use of ice bags for three to four hours offer a measure of control. Physical therapy measures may have some small value but are generally impracticable. Flushing the tissues with salt water is frequently advised but should be discouraged, as this may dislodge the clot and encourage continuation of bleeding and it frequently produces irritating drying of the tissues.

The value of trypsin (Parenzyme, National Drug Company), antihistamines, hyaluronidase, anticholinergic or ataractic agents and other types of drugs which are theoretically related to pain, edema and psychosomatic disorders will not be discussed. There may be subtle aspects to their use which merit caution. Certainly, in selected instances, some have proved to be of value.[3]

Muscle spasm and myositis doubtless play a role in swelling and trismus. Hoffman[4] has found that repository tubocurarine is of value in extreme conditions.

■ *Psychological Factors*

The control of fear and anxiety in the dental patient is related to poise more than in any other professional field. The region of the mouth is particularly related to personality balance owing to the proprioceptive sensations which occur within and about it. Any treatment in this region may seriously disturb the patient's poise and excite aggression.[5,6] Dentists generally are outstanding experts in their capacity to deal with this problem, but it is ever present and requires constant self-control and the study of psychological methods.

■ *Conclusion*

No consideration has been given to the treatment and surgical drainage of phlegmons, as this subject is to be discussed in another report. The elementary aspects of the control of postoperative pain that have been discussed are forgotten from time to time or are temporarily overshadowed by the introduction of a novel panacea. The studious and humane dentist, of course, will frequently review and alter his methods. This paper is intended as a brief guide to satisfactory postoperative relations with the surgical patient.

■ *Addendum*

Very recently a synthetic codeine-like drug, dextro propoxyphene hydrochloride (Darvon, Eli Lilly & Company) has been tested clinically by us. It appears to have good analgesic effect and may be less irritating to the gastric mucosa than codeine.

3. Hoffman, M. M. Chlorpromazine in the relief of pain after oral surgery. J.A.D.A. 53:555 Nov. 1956.

4. Hoffman, M. M. Control of spasm, swelling and pain with repository tubocurarine after removal of impacted third molars. J.A.D.A. 51:547 Nov. 1955.

5. Thompson, Edward C. The personality of the aggressive dental patient. Unpublished.

6. Rangell, Leo. The psychology of poise; with special elaboration on the psychic significance of the snout or perioral region. Internat. J. Psychoanal., London 35:313 No. 3, 1954.

Premedication and sedation for the surgical patient

■ *L. W. Peterson, D.D.S., and C. E. Haynes, D.D.S., St. Louis*

Almost every patient approaches a dental operation with a certain amount of apprehension primarily due to fear of being subjected to pain. Many cover their emotional feelings with an outward air of braggadocio, whereas others freely admit being frightened.

Every patient who is examined prior to a surgical procedure presents a different problem in management. The first duty of the dentist is to be a good observer and listener. Each patient must have an opportunity to tell his story from which much information can be obtained. This story may include a history of a previous unfortunate dental experience, an exaggeration of a friend's experience, an account of inner emotional conflicts and of personality traits, a medical history, both familial and personal, and other pertinent information concerning environmental factors with which the patient has to contend.

Manifestations of anxiety can also be observed and evaluated while the patient is giving his history. Some of these manifestations include perspiration, palpitation, breathlessness, trembling, dizziness, faintness, and sighing. Included in the patient's complaints may be such other signs as occipital headaches, chest pain, paresthesia or numbness, anorexia, nightmares, and chronic fatigue. The recognition of a stress factor in disease is important in treating the patient as a whole. When examining a patient, the dentist must recognize any interreaction of mental, social, and psychological processes in illness and disease. The time allotted for a proper consultation with the patient concerning a surgical problem aids materially in the successful completion of an operation and is time well spent.

The dentist, by the very nature of his work, is constantly under considerable nervous strain and tension. It is far easier for a surgeon to operate on a calm, relaxed patient than on one who is fearful, apprehensive or irritable. There is no procedure in oral surgery or general dentistry that cannot be done under a local anesthetic. However, the great variation in the severity of the surgical problem and the patient's psychological reaction to it require the dentist to make a choice of local or general anesthetic agents that will be the most beneficial for the individual problem.

A dentist, well trained in general anesthesia and one who uses it continually, is apt to be far less fatigued at the end of a strenuous day than another dentist carrying out the same procedures entirely under local anesthesia. With proper preoperative sedation, however, a surgical procedure can be performed with comparable ease under local anesthesia on an otherwise easily agitated patient. The

From the department of oral surgery, Washington University School of Dentistry.

amount of confidence that a dentist conveys to his patient by his manner and approach to a surgical problem is very helpful, but adequate preoperative sedation is also of considerable benefit to both the patient and operator.

A child patient frequently has to undergo a traumatic experience largely because the dentist does not take sufficient time to prepare the youngster properly for an operative procedure. The average dentist has never learned to charge a fee for nonproductive time. Therefore, there is a tendency to use force and restraint in handling a child which only adds to the problem. Actually many children can be successfully managed with a minimal amount of effort as long as a procedure is carefully explained so they know what is likely to happen and how to cooperate with the dentist. Premedication of children has many advantages and should be encouraged. The dosage of drugs should be based on weight, not age. Clark's rule of multiplying the adult dose by the weight of the child in pounds and dividing the result by 150 provides a good guide for calculation of the dose of medication for children.

The advantages and disadvantages and the average dose of the more commonly used drugs for premedication will be discussed.

■ *Barbiturates*

Barbiturates are among the more commonly used drugs for preoperative and postoperative sedation. They may be given orally, in capsule or elixir form, and intramuscularly or intravenously. The barbiturates can be divided into groups, depending on the length of their action. Representative drugs for each group and the average sedative doses are as follows:

Long-acting

Phenobarbital: 0.1 Gm. (1½ grain)
Amobarbital: 0.06 to 0.2 Gm. (1 to 3 grains)

Short-acting

Secobarbital: 0.1 to 0.2 Gm. (1½ to 3 grains)
Pentobarbital: 0.1 to 0.2 Gm. (1½ to 3 grains)

Ultra-short-acting

Thiopental sodium

The barbiturate group of drugs are often combined with analgesics to minimize some of the side reactions of the analgesic drugs and also to provide some central sedation which augments the action of the analgesic medication. Many of the barbiturates are given in small doses three or four times daily for a mild sedative effect which does not prevent a patient from carrying on normal routine activities. Patients with cardiovascular disease are very frequently benefited by this mild sedation.

Thiopental sodium, an ultra-short-acting barbiturate, extensively used as a general anesthetic in oral surgery procedures, can be used rectally as a basal anesthetic for children. The dose must be carefully calculated, however, based on the weight of the patient, and the dentist should be thoroughly skilled in all phases of general anesthesia. Proper equipment for intubation and artificial respiration should be at hand in case there is excessive respiratory depression. The rectal administration of thiopental sodium requires close supervision of the patient if used preoperatively for sedation. The same results can

be achieved using an oral medication in either capsule or elixir form. Oral medication of barbiturates should be given at least 30 to 45 minutes prior to the scheduled surgery.

The use of intravenous pentobarbital or secobarbital eliminates the time element in barbiturate premedication. This method also provides the operator with a remarkably relaxed patient and, when combined with local anesthesia, affords an opportunity to perform the operation under almost ideal conditions. Many patients who might be difficult to manage under a general anesthetic in the office are very successfully operated on under this combined local and sedative medication. For convenience, we have coined the word "loconal" for this combination of medications.

Usually it is better to inject the local anesthetic before the venipuncture is made. An adjunct that can be used in this instance is topical anesthesia before the local anesthetic solution is injected. The use of a topical anesthetic in the form of ointment or spray is a simple procedure which noticeably facilitates the use of a local anesthetic for any patient. The local anesthetic injection should be given before venipuncture because the stimulus of pain produced by the needle may cause an exaggerated reaction in the patient who has been given a drug that is basically a hypnotic and not an analgesic. In the particularly apprehensive patient, a minimal amount of intravenous drug can be given before a local anesthetic is injected. A true hypnotic stage is not approached until the injection is completed. As with thiopental sodium, care must be exercised in making the venipuncture so that the intravenous barbiturate does not escape outside the vessel walls where it can produce irritation and pain.

For relief of symptoms, should this mishap occur, a local anesthetic agent can be injected at the site. The intravenous barbiturate must also be injected fairly slowly, and it is best to use a large enough syringe so that an equal amount of blood can be withdrawn from the vein prior to injection. This dilutes the barbiturate solution which otherwise may have a strong irritating effect on the blood vessel walls because of its acidity and result in a localized phlebitis. When intravenous pentobarbital is injected slowly, the patient's reaction can be watched carefully and the dosage of the drug carefully adjusted. Anyone using intravenous barbiturates should be thoroughly familiar with the principles of anesthesia. In addition, they should have the necessary resuscitation equipment on hand in the office to cope with any emergency.

Barbiturates are contraindicated for patients with a high fever, diabetes mellitus, anemia, porphyria, and congestive heart failure. Geriatric patients do not always react well to these drugs, but there are actually very few outright contraindications to the use of barbiturates. It is more a matter of degree.

■ *True and Synthetic Opiates and Nonopiate Narcotics*

Opiates, true and synthetic, and nonopiate narcotics are largely analgesic in action and are most commonly used for the control of pain although they may also have a sedative action. Drugs in this group and their average analgesic doses include the following:

True opiates

Morphine: 8 to 15 mg. (⅛ to ¼ grain)
Codeine: 15 to 60 mg. (¼ to 1 grain)
Pantopon: 20 mg. (1/3 grain)

Synthetic opiates

Dihydromorphinone hydrochloride: 2 mg.
Dihydrocodeinone bitartrate N.F.: 5 to 15 mg.

Nonopiate narcotics

Methadone hydrochloride: 7.5 mg.
Alphaprodine: 40 to 60 mg.
Meperidine hydrochloride: 40 to 100 mg.

This group of drugs is available in both oral and injectable forms for parenteral and intravenous use. As an adjunct to anesthesia and also as a good analgesic agent, meperidine hydrochloride is perhaps the most widely used in dentistry. It increases the threshold of pain and produces a certain amount of hypnosis and feeling of well-being. Meperidine hydrochloride is a valuable adjunct to intravenous thiopental sodium; it aids in maintaining balanced anesthesia and reduces the amount of barbiturate necessary. Nausea is sometimes manifested in patients given this drug, but it is usually counteracted by the use of barbiturates.

Pantopon is a mixture of purified opium alkaloids as they appear naturally. Codeine has a tendency to cause constipation. Morphine is a respiratory depressant, a powerful analgesic agent, and is used primarily for control of severe pain. The synthetic opiates are in general less potent than the true opiate drugs but minimize to some extent their side reactions.

■ *Tranquilizing Agents*

The following tranquilizing agents are helpful in the control of anxiety and also are effective in alleviating nausea and vomiting resulting from various causes:

Mephenesin NF (65 products available)
Reserpine USP (46 products available)
Chlorpromazine hydrochloride
Meprobamate
Promazine

These drugs have been widely used because of their specific action in psychic and psychosomatic conditions. Many hearty, well-appearing, and outwardly relaxed patients have their true anxiety and tension state well masked by the use of tranquilizing drugs. Most tranquilizing medicaments have qualities which potentiate general anesthetic agents, analgesics, and hypnotics, and as such, it is well for the surgeon to be familiar with the patient's use of them.

The reserpine group of drugs, extracted from Rauwolfia serpentina, have many side reactions and are, in general, excessively potent for use in dentistry. They are used in medicine to aid in the control of hypertension. The chlorpromazine and meprobamate group in many instances have other qualities that make them more desirable to control the apprehensive dental patient.

Chlorpromazine is essentially an antihistamine but is not ordinarily thought of as such. For tranquilizing effect, chlorpromazine is given in 25 mg. doses orally three or four times daily. It can be given parenterally for the control of nausea, and in such circumstances the dosage may be somewhat increased.

The meprobamates are used primarily for tranquilizing effect, but also

have a potentiating action on anesthetic and analgesic drugs and also have muscle relaxant properties. Their average maintenance dose is 400 mg. three times daily. Their toxicity is very low and other than drowsiness, there have been very few side reactions reported. Allergic manifestations, such as fainting, angio-neurotic edema, and urticaria, have been infrequent. Though they are widely used, the true status of these drugs has not as yet been thoroughly evaluated.

The mephenesin group may be used to relieve muscle spasm and bruxism, but their sedative effect is minimal compared to the meprobamates.

These tranquilizing drugs aid the preoperative and postoperative course of the patient undergoing surgery largely by stabilizing emotions, restoring perspective, and keeping the patient in a more cheerful, cooperative mood.

■ *Antihistamines*

There are a large number of antihistaminic drugs available. They may be classified primarily in two categories: those with light sedative action and those with heavier sedative action. The light sedative action group includes such common agents as pyribenzamine, chlor-trimeton maleate and pyrrobutamine, whereas diphenhydramine hydrochloride, promethazine hydrochloride and dimenhydrinate are examples of the heavier sedative group. The dosage is variable, according to the type of antihistamine used.

The antihistamines are valuable aids in preoperative medication and sedation for the surgical patient. Many are also potentiators of general anesthetic agents and are helpful in minimizing some of the common side reactions, such as coughing and hiccoughs, that are sometimes noted with induction of general anesthesia. Dimenhydrinate is not commonly thought of in this connection, and its use has been primarily limited to control of nausea and motion sickness.

There are many injectable types of antihistamines available for both intravenous and parenteral use, and they may be combined with analgesic agents as a preoperative medication. Many are also available in extended action or repeat action form.

■ *Miscellaneous Drugs*

This group of miscellaneous drugs includes a large number that are primarily hypnotic or sleep producers. Some of the more commonly used drugs and their dosages are as follows:

Donnatal: 3 to 6 tablets or tsp. of elixir daily
Scopolamine: 0.5 mg.
Chloral hydrate: 0.5 to 1 Gm. or up to 2 Gm. if necessary
Methylparafynol: 250 to 500 mg.
Sodium bromide: 3 to 5 Gm. daily
Ethinamate: 500 mg. to 1 Gm.

Donnatal is a combination of natural belladonna alkaloids combined with phenobarbital. This produces smooth, central sedation. Donnatal can also be used in the control of adverse gastrointestinal effects of orally administered antibiotics.

Scopolamine, although commonly used as premedication for general anesthesia, also has characteristics that produce a calm patient who is less apprehensive and therefore should be included as a sedative agent although that is not its primary function. Donnatal, plus scopola-

mine, has been used satisfactorily as preoperative medication for children prior to general anesthesia. The Donnatal-scopolamine combination provides sedation, some dryness of the mouth, and a certain amount of amnesia. The dosage should be carefully calculated according to the patient's weight.

Chloral hydrate produces sleep in the absence of pain within 15 minutes after oral administration. It is especially useful in older patients where barbiturates are not too satisfactory. Occasionally, even in moderate doses, chloral hydrate has produced skin lesions and circulatory failure.

Methylparafynol is a hypnotic compound, relatively new, and is used primarily to produce sleep. It is said to have no side reaction, a wide margin of safety, and is free of dangers of habituation and addiction. It is less effective in the presence of pain or agitation.

The bromides are not commonly used in dentistry but have more wide acceptance in medicine to check convulsions, alleviate pain, promote sleep, and allay general nervous excitation. They are not a true somnifacient and have no depressant action on the central nervous system. They obtund general sensibility so that distractions, such as noise and bodily discomfort, are minimized.

Ethinamate is a short acting nonbarbiturate. Its effect is usually initiated within 15 to 20 minutes after administration and terminates in a sufficiently short time so that hangover drowsiness is not a problem. Like the barbiturates, it also affords some protection against excitation frequently associated with local anesthetic agents, but does not provide any degree of amnesia.

■ *Comment*

From the foregoing review, which is only a partial listing and includes only commonly used sedative and analgesic drugs, it can easily be seen that there is no one drug that is a panacea for all patients. When a patient comes for treatment, the dentist must make a careful clinical examination, exercise surgical judgment, and then prescribe to the best of his knowledge and experience. The dentist should be prepared to counteract the side reactions of the various medications and have a thorough knowledge of the pharmaceutical actions of these drugs and the individual dose for both adult and child patients.

Most of the drugs have had a thorough clinical evaluation by the time they are available for use with patients. Many times their action falls short of the drug manufacturer's claims. Frequently, sufficient time has not elapsed for complete evaluation as to prolonged and cumulative effect or troublesome side reactions.

The progressive clinical practitioner is an astute observer. Any medication should not be based on a recorded chart, which is merely a guide, but should be prescribed only after careful consideration of the requirements of the individual patient. With the vast number of medications available today, this becomes an interesting challenge.

General anesthesia for the ambulatory patient

■ *William T. Ewing, D.D.S., and*
Dorral D. Berry, D.D.S., Akron, Ohio

Intravenous barbiturates have been of more value in oral surgery than any other agent since the advent of nitrous oxide. Their introduction has brought the realization of the concept of a perfect general anesthetic for office practice one step closer. The perfect general anesthetic is that which produces unconsciousness without altering the oxygen and carbon dioxide tensions in the patient's lungs.

This paper will explain the most common methods for general anesthesia for the ambulatory patient with the use of various intravenous barbiturates and associated agents, the advantages and disadvantages of each, and why they were developed.

The ambulatory patient can be defined as one who is walking or changing location; namely, one not confined to bed. This category includes the normal patient and also the ill patient.

The ill patient can be ambulatory if the pathologic condition he suffers has been compensated physiologically enough to make this possible.

The hospital patient is one who is confined to bed or who, according to his physician, has not physiologically compensated for his pathologic condition, although he may not be confined to bed.

These explanations serve to point out the patients for whom the following methods were designed; namely, the ambulatory patient.

■ *Barbiturates*

The barbiturates were introduced by Fischer, von Mering, and Dilthey in 1903.[1] They were derived from the nonhypnotic barbituric acid, a condensation of urea and malonic acid. When thiourea is condensed in place of urea, thiobarbiturates are formed.

Their effect on administration is psychic sedation, sleep, deep hypnosis and finally anesthesia.

The long-acting barbiturates are eliminated for the most part in the urine unchanged. The short-acting barbiturates are destroyed in the body, probably in the liver.

■ *Thiopental Sodium*

Thiopental sodium was introduced clinically by Lundy in 1934 as an ultrashort-acting barbiturate for intravenous anesthetic use.

A parenteral solution of 5 to 10 per cent was made with normal saline or distilled water. Injected intravenously, it was used to produce anesthesia. When used alone, however, it was found to produce hypoventilation and circulatory depression;[2] its alkalinity (pH 10) caused

Member, Ewing Oral and Plastic Surgery Group.

1. Adriani, John. Pharmacology of anesthetic drugs, ed. 2. Springfield, Ill., Charles C Thomas, 1941.

2. Schwartz, Herman; Ngai, Shih Hsun, and Papper, E. M. Manual of anesthesiology for residents and medical students. Springfield, Ill., Charles C Thomas, 1956.

phlebitis intravenously and sloughing if it entered the extravenous tissues.

When thiopental sodium was first used for oral surgery procedures, 100 per cent oxygen was administered with it intranasally to eliminate hypoventilation and subsequent circulatory depression. Oral surgeons discovered that by reducing the parenteral solution to less than 2.5 per cent, phlebitis and slough were eliminated. Surgical anesthesia was maintained by intermittent administration of thiopental sodium.

This method proved to be excellent for anesthetizing the resistant patient such as athletes, drug addicts, heavy smokers or highly emotional patients and those with plethora, alcoholism, hyperthyroidism and hypertension. This type of patient was quickly overcome by the powerful sleep-producing agent, thiopental. Recovery was usually rapid, but because of the inebriation created, many times this recovery was stormy.

Those patients easily overcome by anesthetic agents (children, the aged, and patients with hypotension, hypothyroidism, pulmonary disease, or cardiac disease, or those suffering hepatic or renal diseases) could be given adequate oxygen, but had great difficulty overcoming the postoperative inebriation.

Obviously, with thiopental sodium, more patients could be anesthetized in the office, because the complaint of all methods prior to its use was the production of hypoxia. Hypoxia was eliminated, but because of storage of the thiopental in the tissues it was difficult to restore the patient to an ambulatory condition.

Further study revealed that thiopental sodium did not depress the laryngeal reflex in the lighter stages of anesthesia. This resulted in coughing, laryngeal stridor and laryngeal spasm. The cure for these obnoxious sequelae was an increased dosage of thiopental sodium, which increased the postoperative inebriation, further increasing recovery time and enhancing the possibility of nausea.

These characteristics led to the development of various methods of producing anesthesia, employing a series of premedicating, associated anesthetic and postanesthetic drugs in connection with (1) thiopental sodium, (2) thiamylal sodium, (3) secobarbital sodium and (4) methitural sodium.

■ *Premedicating Drugs*

These nonanesthetic drugs were chosen for their specific action in supporting intravenous barbiturates.

ATROPINE SULFATE—Atropine sulfate in small doses (1/150 grain or 0.432 mg.) stimulates the nervous system centrally and depresses the myoneural endings of the parasympathetic division of the autonomic nervous system.[1] This means that the laryngeal reflex is dampened and hyposensitive, so the possibility of coughing, laryngeal stridor and spasm are reduced during light barbiturate anesthesia.

Atropine sulfate, 1/150 grain to 1/100 grain (0.432 mg. to 0.65 mg.) is dissolved in 1 cc. of normal saline or distilled water and given intramuscularly one-half to three quarters of an hour before operating time.

Atropine has two actions—antiparasympathomimetic and antisialogogue.

ANTIHISTAMINES — The antihista-

mines have been found to have three supportive actions:[3]

1. As short-acting analgesics they reduce the amount of barbiturate necessary to overcome the fearful patient.

2. Their antiparasympathomimetic action reduces irritability of the laryngeal reflex.

3. They counteract the release of histamine caused by the presence of the barbiturate in the blood stream.

The antihistamines are given intramuscularly one-half to three quarters of an hour before operating time. The dosage depends upon the antihistamine: chlorpheniramine maleate, 30 to 50 mg.; promethazine hydrochloride, 5 to 10 mg.

ORAL SECOBARBITAL SODIUM—Oral secobarbital sodium has two actions when used for premedication:

1. With its use the operator can tell the patient's reaction to barbiturates and thereby judge the quantity of barbiturate necessary in the anesthetic.

2. It produces excellent hypnotic effects and in many instances decided amnesia, thus reducing the amount of anesthetic barbiturate necessary.

The dosage for adults varies as to age or whether patient falls into the resistant or nonresistant group; thus the dose will vary from 1½ to 3 grains (0.1 Gm. to 0.2 Gm.) orally by capsule one-half hour before operating time.

The dosage for children[2] depends more on the physiological age than the chronological age. The usual dosage recommended is 15 mg. for each year of age up to four or five years and about 10 mg. per year of age for six year olds or over. This is best given orally in the elixir form one-half hour before operating time.

DIMENHYDRINATE — The supportive action of dimenhydrinate is reduction of postoperative nausea.

To be effective it is given 15 minutes before operating time, intravenously. Fifty milligrams of dimenhydrinate is mixed with 10 cc. of normal saline or distilled water to make a solution for parenteral administration.

■ *Associated Anesthetic Drugs and Aids*

Anesthetic and nonanesthetic drugs are used to support the barbiturate during the production of anesthesia.

NITROUS OXIDE-OXYGEN — Nitrous oxide is a mild narcotic, nonexplosive gas. It is never used without oxygen.

After the induction of anesthesia, it is administered intranasally in concentrations of nitrous oxide (80 per cent), oxygen (20 per cent). The concentration of oxygen in the mixture is never lowered, only increased as may be necessary by the demands of the patient. The excellent analgesic properties of nitrous oxide-oxygen serve to reduce the maintenance dose of the barbiturate necessary.

DIVINYL OXIDE—Divinyl oxide is a powerful narcotic, explosive, readily volatile liquid. Because of its high volatility it is an expensive agent.

It is used by "blowing" nitrous oxide-oxygen over a dispenser containing divinyloxide, thus mixing the two together.

3. Silverman, Ronald. Personal communication.

The patient receives this mixture of gases intranasally.

TRICHLOROETHYLENE — Trichloroethylene is a powerful narcotic, nonexplosive, slowly volatile liquid. It is used in the same manner as divinyloxide, which it is gradually replacing because it is inexpensive and nonexplosive.

SUCCINYLCHOLINE CHLORIDE — Succinylcholine chloride[2] is a rapid-acting muscle relaxant, brief in duration, and minimal in toxicity.

It is used after induction at any time during the anesthesia to "break" persistent coughing, laryngeal stridor or spasm. It is injected intravenously in doses of 5 to 20 mg. as necessary. Used in this manner, it may produce apnea for one to two minutes, necessitating artificial respiration.

Another method of administration is continuous drip of 0.1 to 0.2 per cent solution of succinylcholine chloride in 5 per cent glucose to prevent coughing, stridor or spasm.

OXYGEN — Oxygen is necessary to maintain the life of the patient. Since 20 per cent oxygen is received by the patient from the air, the amount administered should never be reduced below this value. It is administered intranasally alone as 100 per cent or in varying concentrations with nitrous oxide.

EPINEPHRINE — Epinephrine is a stimulating drug used as an analeptic.[1] Its action is on the myoneural junction of the sympathetic nervous system.

During anesthesia it is used to "break" a bronchiospasm. It is given intramuscularly in doses of 1 to 3 minims (0.06 cc. to 0.2 cc.) of 1:1,000 solution.

LIDOCAINE HYDROCHLORIDE—A 2 per cent solution of lidocaine hydrochloride is used as a throat spray to reduce irritability of laryngeal reflex. It is a surface anesthetic.

OTHER AIDS—Throat suction is used to remove debris from the throat.

Intranasal and endotracheal tubes assure an adequate airway.

■ *Postanesthetic Drugs and Agents*

Two postanesthetic sequelae which must be considered as part of ambulatory anesthesia are inebriation and nausea. The inebriation can be the result of storage of the barbiturate (the body synthesizes about 15 per cent per hour) or loss of blood volume (resulting loss of sugar and salts.)

Caffeine orally or intramuscularly is most effective for inebriation due to a barbiturate. Coffee or 7 grain (0.45 Gm.) tablets of caffeine given orally or caffeine sodio-benzoate intramuscularly is helpful.

Intravenous administration of 500 cc. of normal saline solution bolstered with 50 cc. of 50 per cent glucose is used for inebriation due to blood loss. This same treatment is most effective for postanesthetic nausea, especially a seemingly irreversible type. A history of diabetes of course, contraindicates the use of glucose.

■ *Other Methods of Anesthesia*

In 1947, the principle of "balanced anesthesia" was presented to the American

Society of Oral Surgeons.[4] This method employed thiopental sodium as the basic anesthetic agent but combined nitrous oxide and oxygen with it to assure a more rapid recovery yet allow sufficient oxygen. From this method grew the following commonly used technic of anesthesia for the ambulatory patient.

THIOPENTAL SODIUM AND NITROUS OXIDE—The patient is premedicated with 1/100 grain (0.65 mg.) of atropine and 30 mg. of chlorpheniramine maleate or 5 to 10 mg. of promethazine hydrochloride. These drugs are made into solution with normal saline solution so that 1 cc. contains the proper proportions. This is then injected intramuscularly one-half hour before anesthetic.

Induction is accomplished by injecting a 2 per cent saline solution of thiopental sodium intravenously until the mandible is relaxed and the lash reflex is abolished. At this time a mixture of nitrous oxide and oxygen (20 per cent) is given the patient intranasally. Further injection of the thiopental sodium will carry the patient into a surgical plane of anesthesia. Through intermittent administration of thiopental sodium the patient can be maintained in this stage.

If there is any interference with the patient's oxygen receiving, carrying or utilization power, the oxygen content of the gaseous mixture can be varied to prevent hypoxia.

The advantages of this method of anesthesia are:

1. The patient is rendered insensible to external stimuli by the powerful hypnotic, thiopental sodium, which enhances the analgesic powers of nitrous oxide-oxygen, which in turn allows the patient to be maintained in anesthesia without overdose of the barbiturate.

2. Recovery is considerably more rapid with this method than with the use of thiopental sodium alone as the anesthetic agent.

The disadvantages are:

1. There is a possibility of laryngeal stridor and spasm.

2. Postanesthetic inebriation may occur.

THIAMYLAL SODIUM AND NITROUS OXIDE-OXYGEN—Using the same methods of administration as for thiopental sodium anesthesia, Lund[5] gave an excellent appraisal of thiamylal sodium. It was found that thiamylal sodium was more powerful than thiopental sodium; it produced less respiratory depression and less hypersensitivity of laryngeal, and pharyngeal reflexes and recovery was more rapid.

In comparison studies made by the Ewing Oral and Plastic Surgery Group, the same differences were observed as those by Lund; however, the postanesthetic inebriation still existed as a problem. It was also found that it was difficult to maintain an even surgical stage of anesthesia because of prolonged apnea and rapid recovery to lighter stages of anesthesia.

SECOBARBITAL, NITROUS OXIDE-OXYGEN AND TRICHLOROETHYLENE — The method of anesthesia employing secobarbital sodium, nitrous oxide-oxygen and tri-

4. Ewing, W. T. Combined anesthesia in oral surgery. Unpublished.

5. Lund, P. C. Intravenous thiamylal sodium anesthesia and the modern muscle relaxants in oral surgery: an appraisal. J. Oral Surg. 15:119 April 1957.

chloroethylene[3] was developed in practices in which the patients came from long distances and was utilized in an attempt to eliminate postanesthetic inebriation.

Preanesthetic medication consists of chlorpheniramine maleate 30 mg. mixed with atropine sulfate 1/150 grain (0.432 mg.) injected intramuscularly. Secobarbital sodium, 1½ to 3 grains (0.1 to 0.2 Gm.) is given perorally. The dose is administered 30 to 45 minutes before time for anesthesia to be induced.

After the premedication has become effective, secobarbital sodium for the intravenous use (5 per cent) is injected slowly until reflexes are absent. In most instances this is noted with a 3 to 5 cc. dose. Nitrous oxide-oxygen (20 per cent) is then administered with small amounts of trichloroethylene being evaporated into this mixture.

When the relaxation is complete, the intravenous needle is withdrawn from the vein and the patient is carried on the induction dose of secobarbital sodium plus nitrous oxide-oxygen and trichloroethylene.

The advantages in this method are:

1. Secobarbital sodium possesses a longer range of action than the ultra-short-acting barbiturates. So, when combined with the excellent analgesic properties of nitrous oxide-oxygen and trichloroethylene, it produces a well-balanced anesthetic for either short or long procedures.

2. Secobarbital sodium subdues the laryngeal and pharyngeal reflexes, so that coughing, laryngeal stridor or spasm are rarely seen.

3. Recovery time is excellent, and postanesthetic inebriation is seldom observed. Early ambulation is no problem.

4. From an economic standpoint this method is excellent since the necessary added equipment is only a 10 cc. syringe and needle.

The disadvantages are:

1. The possibility of hypoxia exists.

2. This method is not as pliable as the intermittent method of barbiturate anesthesia. The difficulty is that the oxygen cannot be varied to fit the demands of the patient.

3. Prolonged amnesia may be produced when this method is used for very short operative procedures.

THIOPENTAL, NITROUS OXIDE-OXYGEN AND SUCCINYLCHOLINE — Thiopental sodium, nitrous oxide-oxygen and succinylcholine chloride also are used to produce anesthesia.[6] The patient is induced with a 2 per cent intravenous thiopental sodium solution in distilled water (succinylcholine is not compatible with normal saline solution) until the eye reflex is sluggish or abolished.

Nitrous oxide (70 per cent) and oxygen (30 per cent) mixed with evaporated trichloroethylene are then administered for analgesia. At this point an 0.2 per cent succinylcholine intravenous drip in 5 per cent glucose is used for relaxation. The rate of drip is adjusted to about 60 drops per minute. Of course this can be lessened or stopped at any time, depending on reaction of the patient.

The advantages of this method are:

1. It provides a controlled degree of relaxation under comparatively light anesthesia.

6. Methven, John. Use of succinylcholine in general anesthesia. Unpublished.

2. Using a dilute solution (0.2 per cent) of succinylcholine chloride maintains this degree of relaxation without producing paralysis of the muscles of respiration.

3. The use of succinylcholine chloride prevents or overcomes coughing, laryngeal stridor or spasm.

4. Succinylcholine chloride is destroyed rapidly, two or three minutes after the drip is stopped, thus it does not interfere with recovery time.

5. The use of succinylcholine chloride enables the anesthetist to use a minimum of the barbiturate, so that accumulation with resulting slow recovery and inebriation is prevented.

The disadvantages are:

1. The possibility of respiratory paralysis is present. If it occurs, prolonged artificial respiration is necessary.

2. Elaborate equipment is needed to carry out this method.

METHITURAL SODIUM AND NITROUS OXIDE-OXYGEN—This method of administration is the same as the methods described for thiopental sodium and thiamylal sodium. The same premedicating drugs are used in the same manner. The only difference lies in the increase in the basic oxygen content of the nitrous oxide-oxygen mixture to 30 per cent. The following advantages and disadvantages are based on the clinical observation of over 3,000 clinical administrations of anesthesia for oral surgical procedures.

The advantages are:

1. A rapid recovery without inebriation.

2. Reduction in the irritability of the laryngeal and pharyngeal reflexes.

3. The effectiveness for children, mentally retarded and aged patients. Their postanesthetic orientation is remarkable.

The disadvantages are:

1. The increased quantity required. As compared to thiopental sodium and thiamylal sodium, it is necessary to use about one third more methitural sodium to accomplish comparable procedures.

2. Sequelae. Coughing and hiccuping are encountered, but are without consequence. It is thought that a slow induction will reduce these obnoxious sequelae.

■ *Conclusion*

The time-proven drugs, aids and methods covered in this paper constitute a study of modern general anesthesia for the ambulatory patient. Other methods and drugs are used, but are usually variations of those already explained.

Obviously the search continues for the perfect anesthetic agent or combination of agents. This review shows the strides oral surgeons have made in the past 20 years. It also serves to point out that the producing of general anesthesia in the ambulatory patient is a specialty in its own right.

Today the dental anesthesiologist must have not only a year of training with a recognized anesthesiologist, but a thorough knowledge of anatomy, physiology, pathology and pharmacology as well as anesthesiology.—*183 West Bowery Street.*

Control of postoperative hemorrhage

■ *Robert B. Shira, D.D.S., Washington, D. C.*

Hemorrhage associated with oral surgical procedures usually stops spontaneously. A normal hemostatic mechanism is necessary for survival, and most individuals have a nature-given system to control bleeding. Postoperative hemorrhage after oral surgical procedures is occasionally encountered, however. The bleeding episode may cause considerable alarm to both patient and surgeon and, on occasion, it may reach serious proportions. Postoperative hemorrhage is a complication that practically every practitioner of dentistry must cope with at some time during his professional career, so a thorough understanding of the problem is essential.

The majority of postoperative bleeding problems are local in character and usually present little difficulty in management. Bleeding problems of a systemic nature resulting from one of the hemorrhagic disorders, however, are encountered occasionally. The dentist should always be aware of this problem in order to prevent becoming involved in embarrassing and serious situations. Howell and Monto's[1] report that over 25 per cent of 250 patients with hemorrhagic disease seen at Henry Ford Hospital were referred to the hematology service by the oral surgical group is evidence of the fact that patients with bleeding tendencies are seen in dental offices. Hemorrhage in one of these patients is a major problem that requires specialized therapy.

In this discussion, primary attention will be given to the postoperative bleeding problems of local origin occurring in patients who do not suffer from one of the hemorrhagic disorders. These patients are most frequently treated by the dentist or oral surgeon in his office on an out-patient basis.

■ *Physiology of Hemostasis*

Hemostasis is a complex process which depends on three factors—the vascular system, the blood platelets, and the blood coagulation mechanism. Under normal circumstances, when bleeding is produced by trauma or surgical procedures, a sequence of events is set up that ultimately results in arrest of the hemorrhage. The first event is a brief vasoconstriction in the region of injury. This is temporary and lasts from 15 to 30 seconds.[2] It is felt that this vasoconstriction reduces the speed of blood flow and allows the platelets to draw closer to the vessel walls. This is followed by an agglutination and lysis of the platelets in the regions where the vessel walls have been disrupted.

The breaking down of the platelets liberates powerful factors that play a key

Colonel, Dental Corps, U.S. Army; chief, oral surgery section, dental service, Walter Reed Army Hospital.

1. Howell, J. T., and Monto, R. W. Recognition and management of bleeding disorders in oral surgery. J. Oral Surg. 11:129 April 1953.

2. Stefanini, M., and Dameshek, W. The hemorrhagic disorders. New York, Grune & Stratton, 1955, p. 2.

role in the hemostatic process.[3] One of these factors, known as serotonin, induces a generalized vasoconstriction for as long as 30 minutes. This vasoconstriction is evident not only in the injured vessels but in the intact vessels as well, and effectively reduces blood flow in the region of injury. The coagulating mechanism then makes its appearance to produce fibrin threads which soon clump together and form a fibrin plug. This plug traps intact platelets and other blood cells in its substance. It then retracts and effectively blocks the tears in the vessel walls and produces hemostasis. This phase has often been referred to as "temporary hemostasis."

After this phase, the blood clot undergoes organization. Part of it is digested and the remainder is invaded by proliferating connective tissue which permanently seals off the tears in the vessel walls. A slow process of recanalization then begins which may take weeks or months to complete. Finally, endothelium proliferates from the normal vessels at either end and relines the new lumen, thus re-establishing the continuity of the vessel. This latter process is referred to as "permanent hemostasis."

It is evident that hemostasis is dependent on a normal vascular system to insure contractibility at the site of injury, normal platelets to supply the powerful factors which induce vasoconstriction and play an important role in the coagulating mechanism, and a normal process of coagulation to insure the formation of the fibrin clot. When any of the three factors are abnormal, hemorrhagic disorders may occur.

A detailed description of the coagulating mechanism cannot be covered here, since entire chapters[2,4,5] and even books[6] have been written on the subject. Many theories have been advanced regarding this mechanism, and it is impossible to present a unified theory of blood coagulation that would be acceptable to all investigators. Most agree, however, that it is a process involving at least two steps—the conversion of prothrombin to thrombin with thromboplastin and calcium acting as catalysts and accelerators, and the conversion of fibrinogen to fibrin by the thrombin.

The blood plasma and platelets play a vital role in this process. The plasma contains many substances necessary for clotting. Among these are prothrombin, fibrinogen, calcium, antihemophilic globulin, and plasma accelerator globulin (referred to by various authorities as Factor V,[7] prothrombin A,[8] prothrombokinase,[9] prothrombin accelerator,[10] and labile factor[2]). It also undoubtedly contains other agents concerned with the coagulating of the blood. The platelets supply thromboplastin, serotonin, and the various platelet accelerators which act as catalysts in the clotting reaction.

According to Aggeler and Lucia,[4] the following sequence of events occurs during formation of the blood clot. When

3. Stefanini, M. Basic mechanisms of hemostasis. Bull. New York Acad. Med. 30:239 April 1954.

4. Aggeler, P. M., and Lucia, S. P. Hemorrhagic disorders. Chicago, University of Chicago Press, 1949, p. 5.

5. Quick, A. J. Hemorrhagic diseases and the physiology of hemostasis. Springfield, Charles C Thomas, 1942, p. 3-97.

6. Biggs, R., and Macfarlane, R. G. Human blood coagulation and its disorders. Oxford, England, Blackwell, 1953.

7. Owren, P. A. Coagulation of blood: investigations on new clotting factor. Acta med. Scandinav., suppl. 194, 1947.

8. Quick, A. J. On constitution of prothrombin. Am. J. Physiol. 140:212 Nov. 1943.

9. Milstone, J. H. Three-stage analysis of blood coagulation. J. Gen. Physiol. 31:301 March 1948.

10. Fantl, P., and Nance, M. H. Physiological activation of prothrombin. M.J. Austral. 1:128 Jan. 31, 1948.

blood is shed, the platelets agglutinate and undergo lysis, thus liberating thromboplastin and certain platelet accelerators. Additional thromboplastin is liberated by the injured tissue cells. This accumulated thromboplastin, in the presence of calcium, acts on the plasma prothrombin to form thrombin. An accelerator factor liberated by the platelets catalyzes this process. This initial step is slow, but the first thrombin formed acts as a catalyst to transform the inactive plasma accelerator globulin to active serum accelerator globulin. This activated serum accelerator globulin in turn acts as the principal catalyst for the rapid conversion of prothrombin to thrombin. The thrombin in turn converts fibrinogen to fibrin, which is the end stage of the process. The entire process may be summarized by the steps shown below.

Although this abbreviated description does not include the intermediate steps in the formation of thromboplastin (including the role of antihemophilic globulin, plasma thromboplastin component[11] and plasma thromboplastin antecedent[12]) or the possibility of a process that changes prothrombin from an inactive to an active form, it is sufficient for this discussion.

■ *Treatment of Postoperative Hemorrhage*

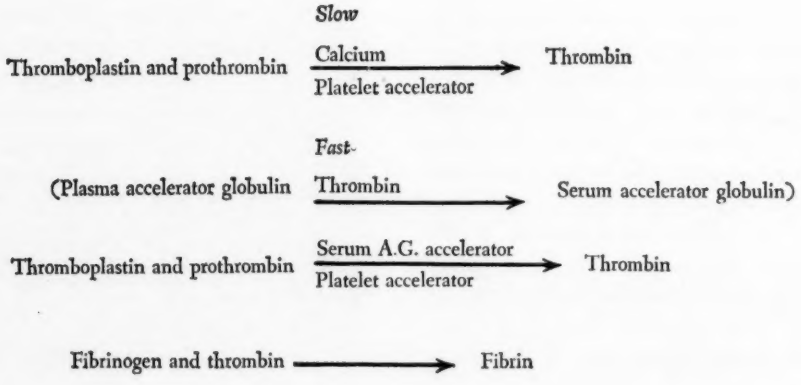
Hemorrhage after oral surgical procedures has been classified as primary, intermediate, or secondary, depending on the time the bleeding occurs.[13] Bleeding that occurs during surgery or continues unabated after surgery is referred to as primary hemorrhage. Bleeding that recurs within a few hours is referred to as intermediate hemorrhage, and bleeding that occurs after 24 hours is referred to as secondary hemorrhage.

Intermediate hemorrhage occurs after temporary hemostasis has been produced and may be the result of premature removal of pressure pads, rinsing of the

11. White, S. G.; Aggeler, P. M., and Glendening, M. B. Plasma thromboplastin component (PTC). Hitherto unrecognized blood coagulation factor. Blood 8:101 Feb. 1953.

12. Rosenthal, R. L.; Dreskin, O. H., and Rosenthal, N. New hemophilia-like disease caused by deficiency of third plasma thromboplastin factor. Proc. Soc. Exper. Biol. & Med. 82:171 Jan. 1953.

13. Bradley, J. L., and Jakubs, S. Postoperative hemorrhage in oral surgery. Oral Surg., Oral Med. & Oral Path. 9:352 April 1956.



mouth, or an elevation of the blood pressure which may displace the clot. Secondary hemorrhage is also a reappearance of bleeding after temporary hemostasis has been obtained and is usually caused by a premature separation of the clot, additional trauma, or infection.

Management of the three types of postoperative hemorrhage is essentially the same and consists of local as well as systemic measures. Local measures are necessary in all instances of postoperative hemorrhage, whereas systemic measures are required only when a bleeding disorder is involved or when the blood loss has been sufficient to require replacement therapy. The dentist or oral surgeon is primarily concerned with local measures, for if systemic therapy is required, hospitalization and consultation with a hematologist are indicated. Local therapy, for the most part, consists of applying continuous pressure to the bleeding area. Adequate rest and application of cold to the area are additional measures of value in bringing the hemorrhage under control.

Usually the first indication that a patient is having difficulty is a telephone call from the patient or a relative stating that excessive or continuous bleeding is occurring. This bleeding is difficult to evaluate without seeing the patient, since many patients become apprehensive when they continue to bleed and tend to exaggerate the magnitude of the problem. An attempt should be made to determine the amount of hemorrhage.

If the hemorrhage is not massive and is not flowing profusely from the operative site to fill the mouth rapidly with blood, local measures applied by the patient may save him an office visit. He should be advised to rinse his mouth to eliminate as much of the old blood clot as possible and then apply firm pressure to the bleeding area by biting the gauze. Frequently this is all that is necessary to arrest the bleeding. Biting on a moistened tea bag is also an effective way of applying this pressure. The patient should be contacted within an hour to see if these measures have been successful. If not, or if the patient is frightened and apprehensive, he should be seen at once.

When the patient is seen in the office, all visible evidence of the hemorrhage should be removed. These patients frequently arrive with blood on the face, hands, and clothing, carrying a pan or similar container into which they have been expectorating, and with bloodstained towels or absorbable tissues very much in evidence. These objects should be removed and the patient taken into an operating room, away from their relatives where the operator may go quietly about his procedures to control the bleeding. The patient should be reassured that the bleeding will soon be brought under control and that there is no need for alarm.

A large gauze pad should be placed over the bleeding area to exert pressure on the bleeding point as a temporary measure while the necessary supplies and instruments needed to control the bleeding are obtained. Any blood on the face and hands should be removed and bloodstained clothing covered with drapes. A sedative may be administered if the patient is in pain or is restless and apprehensive. The bleeding region should be anesthetized to relieve pain and to permit any operative procedure that may be necessary to stop the flow of blood. A

strong suction apparatus should be available to remove the blood and saliva so that good vision of the bleeding area is possible. Large blood clots may be seen extending from the wound, in which case they should be removed to permit visualization of the bleeding site.

At this point the type of bleeding and the origin of the hemorrhage should be determined. Arterial bleeding produces a spurting of bright red blood. Venous bleeding is characterized by a slow continuous flow of darker blood, and capillary bleeding is more of a continuous oozing.[14] The hemorrhage may be arising from the bone or overlying soft tissue. If the bleeding is from the bone, all the remaining blood clot should be removed to permit visualization of the socket. If a spurting bleeder is located, it can be controlled by crushing the bone with a hemostat or by burnishing with a blunt instrument.

A spurting type of hemorrhage arising from bone is seldom seen as a postoperative complication; the bleeding is most frequently a seepage or a continuous, brisk flow. Most of these sockets must be packed to control the hemorrhage. Gelfoam, Oxycel, or any of the other absorbable hemostatic substances may be utilized to pack the socket and these agents effectively control bleeding in most instances. They may be left in the wound without deleterious effect.

Stubborn, persistent bone bleeding is seen occasionally in instances where the absorbable sponges fail, and packing with iodoform or plain strip gauze must be utilized. A firm, definitive pressure can be maintained with gauze packing which is impossible with the absorbable hemostatic agents and should be considered the treatment "par excellence" when other methods fail. Suturing the soft tissue across the socket to maintain the packing in place is considered good practice. The gauze should be allowed to remain in place three or four days and then be carefully removed. Slight hemorrhage may attend the removal of the gauze, but this bleeding is seldom a problem. If bleeding does recur on removal of the packing, the socket should be repacked as often as necessary.

Hemorrhage arising from the soft tissue calls for a thorough examination of the operated region to determine the cause of the bleeding. Any bone spicules, irregular sharp bone margins, or vascular granulation tissue in the region should be removed.[15] Arterial hemorrhage is best managed by grasping the bleeding point with a hemostat and applying a ligature to the bleeding area. The "spurting" arterial type of hemorrhage, like the postoperative bleeding arising from bone, is rarely seen in postoperative soft tissue bleeding. In most of the soft tissue hemorrhages, there is a steady flow of blood from ruptured vessels or capillary oozing that may often be brought under control by pressure alone.

By removing the remaining blood clot and utilizing the suction to permit clear vision of the bleeding area, a gauze pad may be placed directly over the bleeding area and firm, continuous pressure applied with a finger or by having the patient bite into the gauze. The pressure should be maintained for 15 to 20 minutes. If this procedure is not effective,

14. Thoma, K. Oral surgery, vol. 1, ed. 2. St. Louis, C. V. Mosby Co., 1952, p. 184.

15. Rossi, D. J. Controlling hemorrhage in exodontia and oral surgery. D. Clin. North America, July 1957, p. 349.

sutures should be applied through the soft tissues in such a manner that the tissue is drawn firmly over the underlying bone. This brings pressure on the bleeding points and in the majority of instances will control the bleeding immediately. Supplemental pressure with gauze pads is usually employed.

All of these procedures have one thing in common—they produce continuous pressure on the bleeding area until hemostasis is produced. This direct pressure is often made more effective by the topical application of vasoconstrictors or coagulation-promoting agents to the bleeding area, and these valuable agents will be considered later in this article.

After the hemorrhage has been brought under control, supplemental supportive measures should be instigated. Rest is essential, and it is wise to hospitalize the patient who has suffered from prolonged hemorrhage. Such patients are weak and lethargic. They have a weak, rapid pulse, a lowered blood pressure, and a cold, pale skin and mucosa. They are in incipient shock and blood transfusions may be indicated to restore normal blood volume. When it is considered unnecessary to hospitalize the patient, home rest should be prescribed. The patient should be quiet, preferably resting in bed with the head elevated to reduce local blood pressure. Adequate sedation for pain and anxiety should be provided.

The area from which the hemorrhage occurred should be protected from further trauma that might dislodge the clot and instigate further bleeding. Conversation by the patient should be discouraged. A liquid diet should be prescribed, and no rinsing of the mouth permitted. Application of cold to the areas adjacent to the bleeding sites may prove beneficial, since cold produces a continuous vasoconstriction and is of value in controlling hemorrhage. Ice caps applied to the face and neck and ice chips held in the mouth are means of applying cold.

If bleeding persists in spite of these therapeutic measures, suspicion should be aroused that some systemic bleeding disorder might be present. This is particularly true if the bleeding is oozing in character and persists for several days. In these instances, laboratory tests should be ordered to determine if abnormalities in the hemostatic mechanism are present. The tests should include the coagulation time, the bleeding time, a platelet count, the prothrombin concentration, and the capillary fragility. If aberrations are noted, the patient should be referred to a hematologist or internist for consultation. These specialists will perform or order any additional laboratory procedures necessary to establish a diagnosis and supervise any systemic therapy that may be indicated. Hospitalization of these patients frequently is necessary.

A form of postoperative hemorrhage which is not serious but often causes the patient alarm is the soft tissue ecchymosis occasionally seen after oral surgical procedures. This occurs most frequently in women who have a history of easy bruising and in elderly patients with decreased capillary resistance and poor tissue tone (Fig. 1). In these patients, there may be continued postoperative subcutaneous oozing which finally stops as pressure is built up in the tissues. The accumulated blood in the soft tissues then clots and produces a discoloration of the skin that is at first

Fig. 1—Ecchymosis of soft tissue after extraction of lower anterior teeth.

purple and then fades to a greenish yellow. Complete resolution takes place in from 10 to 14 days. Little can be done to prevent this phenomenon. Careful handling of the tissue and meticulous attention to hemostasis at the time of surgery are of value, but in spite of all precautions, ecchymosis frequently cannot be avoided. It is well to warn these patients preoperatively that discoloration of the skin is likely to occur.

■ *Prevention of Postoperative Hemorrhage*

As with so many of the complications encountered in dentistry, the best treatment for postoperative hemorrhage is prevention. Preventive measures should include a thorough screening of patients to eliminate those with bleeding disorders, the employment of sound surgical procedures at the time of surgery with meticulous attention to hemostasis, and instigation of a careful postoperative regime.

The first consideration prior to any surgical procedure should be a thorough evaluation of the patient. For this evaluation a careful history should be taken, a cursory physical examination made, and any necessary laboratory procedures carried out. These findings may point toward a bleeding tendency that would make oral surgical procedures hazardous.

The history should reveal any abnormal hemorrhage after previous surgery or traumatic episodes. Particular attention should be directed to any bleeding associated with previous extractions. A history of easy bruising and information about members of the family with bleeding tendencies are of importance. A patient with a condition that predisposes to bleeding will usually have experienced other episodes of bleeding or extravasations of blood that will give a clue to the problem.

When a positive bleeding history is obtained, the location as well as the duration, amount, and type of bleeding will give valuable information regarding the severity of the bleeding disorder. Howell and Monto[1] have ably described the significance of these observations. They feel that spontaneous bleeding, usually from the mucous membranes, has a more serious implication than hemorrhage after trauma or surgical procedures, and that continuous bleeding episodes are more serious than intermittent hemorrhages, even though the latter may extend over considerable periods of time. They also feel that the presence of a serious bleeding disorder is usually manifested by bleeding in multiple organ systems, and it is important to know of previous or concomitant bleeding from regions other than the mouth.

The amount of blood loss is significant but difficult to evaluate. In their

opinion, small amounts of blood-tinted saliva are not significant, whereas copious, prolonged bleeding may have a serious implication. A history of vomiting of blood will give additional information on the amount of blood loss. Bright red blood usually indicates arterial bleeding of local origin whereas seepage of dark red blood may indicate a systemic hemorrhagic disorder. Bleeding that occurs three or four days after an operative procedure usually denotes hemorrhage of local cause due to premature separation of the clot, additional trauma, or infection. Bleeding in males which begins four to six hours after the procedure and is oozing in character may be an indication of hemophilia. Bleeding that is continuous throughout the night points to systemic disease more than does bleeding that occurs only during the day. In evaluating bleeding tendencies, they have also found it of value to know whether the patient had required blood transfusions at any previous time.

The history should also reveal any systemic disease that may produce associated bleeding tendencies. Hypertension, anemia, liver disease, heart and vascular diseases in which the patient is on anticoagulant therapy, or arthritic patients who are taking large amounts of salicylates, all produce conditions that may result in prolonged bleeding. In some patients a well established diagnosis of a hemorrhagic disorder or blood dyscrasia will be encountered which would definitely contraindicate oral surgical procedures.

Physical examination is not normally within the realm of the dentist; however, mere observation of the patient may reveal conditions that suggest hemorrhagic disorders. The pale, weak, lethargic appearance of patients with leukemia, the petechiae and ecchymosis of thrombocytopenic purpura, the enlarged joints of the hemophiliac, the yellow tint of the skin and sclera of the jaundiced patient, are familiar signs that warn of potential hemorrhage in event of surgery or trauma. The pale lips, nail beds, and mucosa of anemia and enlarged cervical lymph nodes that may denote a bleeding disease are additional signs of significance in this preoperative evaluation.

Laboratory tests are necessary to establish a diagnosis of a hemorrhagic disorder. Most dental offices are not equipped to do the necessary tests; therefore, when it is determined from the history and cursory examination that a bleeding tendency may be present, the patient should be referred to a hematologist or internist for consultation and diagnosis. If a bleeding tendency is confirmed by this referral, specialized therapy is required in the event oral surgical procedures are necessary. The best interests of all will be served if no attempt is made to perform the surgery in the office of the general practitioner or the oral surgeon. The patient should be referred to a specialized treatment center where adequate hospital and laboratory facilities are available and where he will be under the care of competent specialists in the fields of hematology, internal medicine and oral surgery.

In the normal patient, postoperative hemorrhage may be minimized by careful attention to surgical principles and hemostasis at the time of surgery. Sharp bone margins and bone splinters should be removed, since they cause irritation and

may predispose toward secondary hemorrhage. Pathologic soft tissue should be removed at the time of surgery, since, for the most part, this tissue is highly vascular and is conducive to continued hemorrhage if allowed to remain. Bleeding from bone should be controlled before closure of the soft tissue, and any intraseptal "spurters" should be managed by crushing the bone at the bleeding point with a blunt instrument.

Profuse hemorrhage from injury of the inferior alveolar vessels should not be ignored but should be controlled by packing with gauze or one of the absorbable hemostatic agents. Soft tissue bleeding at the time of surgery should also receive attention.

Although spurting arterial hemorrhage is seldom seen in dentoalveolar surgery, it may occasionally be encountered in palatal surgery or in removal of impacted mandibular third molars if the incision is placed too far lingually. These bleeding points should be grasped with a hemostat and tied with an absorbable ligature. Brisk seepage is frequently encountered from the granulation tissue associated with various pathologic conditions of the oral cavity. Recognition of the granulation tissue is not difficult since it presents a characteristic dark purplish red color and its removal at the time of surgery is indicated. An immediate decrease in the amount of bleeding is usually evident on removal of this tissue. Soft tissue flaps should be returned to their normal position and maintained with sutures. The use of sutures to prevent postoperative hemorrhage cannot be overemphasized. The additional time required to place a few well situated soft tissue sutures will frequently pay large dividends in the prevention of postoperative hemorrhage.

A careful postoperative regime is also important as a prophylaxis against hemorrhage. This may seem unimportant, but postoperative hemorrhages do result from neglect of these few simple procedures. A gauze pad should be placed over the operative site and the patient advised to maintain pressure on the pad for several hours. (On occasion a patient misinterprets this instruction and maintains the pressure pad over night. It is amazing to see how well the wound appears the following day.) The patient should be instructed to go home and rest and not attempt to combine the appointment for a surgical procedure with a shopping tour. Mouth rinsing should not be permitted for at least 24 hours, and measures to protect the blood clot should be taken. This includes a soft or liquid diet, no tooth brushing for the first day, and no strenuous exercises. Cold applications to induce vasoconstriction, and administration of an analgesic to control pain should be included. The patient should be instructed to notify the surgeon immediately of any profuse bleeding.

■ *Local Hemostatic Agents*

Although postoperative hemorrhage usually can be controlled by direct pressure, a bleeding problem may be encountered occasionally that warrants the use of local vasoconstrictors or coagulation-promoting agents. There are several valuable agents which should be included in the armamentarium of the surgeon.

Epinephrine is a powerful vasoconstrictor that is effective in arresting capil-

lary hemorrhage when applied topically to the bleeding area. It is usually applied in aqueous solutions of 1 to 50,000. The hemostatic action persists as long as the epinephrine is present, but after it disappears the capillaries usually dilate. This may result in delayed hemorrhage if a firm blood clot has not been formed.

Certain chemical cauterizing agents have been used to treat postoperative hemorrhage. Monsel's solution (ferric subsulfate), Ferropyrin, and tannic acid are the agents most frequently employed. They are effective hemostatic agents because of their ability to coagulate tissue and blood proteins.[16] They do, however, possess the disadvantage of causing local tissue destruction and are being replaced by more desirable substances such as thrombin or thromboplastin.

Thrombin is an effective hemostatic agent capable of clotting blood rapidly by acting on the fibrinogen.[17] To be effective, it must be placed in contact with the bleeding capillaries. It is supplied in powdered form and may be reconstituted with distilled water before use. It may be applied directly to the bleeding area or used to saturate gauze or one of the absorbable sponges before placement against the bleeding surface. Its effectiveness is increased when steady pressure on the area is maintained. Topical thrombin should be considered the agent of choice when one of the coagulation-promoting agents is indicated.

Thromboplastin is still another agent that may be utilized. It is used in the same manner as thrombin, and by its action on prothrombin it produces thrombin which in turn is responsible for coagulation of the blood. Thromboplastin is not as effective as thrombin in producing hemostasis.

Two snake venoms which possess powerful hemostatic action may be used for topical application. Stypven or Russell viper venom contains a proteolytic enzyme which converts prothrombin to thrombin.[18] The fer-de-lance venom owes its action to proteolytic enzymes which are capable of converting both prothrombin to thrombin and fibrinogen to fibrin.[19] It is in short supply and is difficult to obtain.

Absorbable hemostatic dressings are available which are valuable in the management of postoperative bleeding. Fibrin foam, derived from human fibrinogen, and Gelfoam, prepared from partially denatured gelatin, are similar in nature and form a spongy porous mass which may be cut into any desired shape. Fibrin foam, being a derivative of human blood, is expensive, and Gelfoam, therefore, is the substance most frequently used. When placed in a wound, it absorbs blood into its interstices, and the blood clot that forms binds the sponge to the underlying tissues. It is an ideal medium for carrying thrombin or other hemostatic agents into a bleeding area and is very effective in promoting hemostasis.

Oxycel and the other absorbable cellulose materials are prepared by the oxidation of cotton or gauze. They maintain about the same texture as the original material. When applied to a bleeding wound, a coagulum is formed by the interaction of this substance and the hemo-

16. Aggeler, P. M., and Lucia, S. P. Hemorrhagic disorders. Chicago, University of Chicago Press, 1949, p. 86.

17. Tidrick, R. T.; Seegers, W. H., and Warner, E. D. Clinical experience with thrombin as hemostatic agent. Surgery 14:191 Aug. 1943.

18. Page, R. C., and Thomas, E. G. Local application of Russell viper venom for control of hemorrhage. M. Clin. North America 24:777 May 1940.

19. Aggeler, P. M., and Lucia, S. P. Hemorrhagic disorders. Chicago, University of Chicago Press, 1949, p. 85.

globin. Because of its acid character, Oxycel is incompatible with thrombin and when it is used as a carrier for thrombin, it must first be neutralized with a solution of 1 per cent sodium bicarbonate. The absorbable sponges are valuable agents in the control of postoperative hemorrhage and may be left in the wound without deleterious effects.

■ *Systemic Hemostatic Agents*

Much has been written on the value of certain drugs, which, if administered orally, would exert a favorable influence on the coagulating mechanism. Among the substances recommended are calcium gluconate, calcium lactate, vitamin D, styptase, ceanothyn, gelatin, fibrinogen, histidine and coagulen. There is little rationale for these recommendations. Although it is true that calcium is necessary in the coagulation process, it is highly improbable that a calcium deficiency of sufficient magnitude to produce a bleeding disorder would be encountered. Hence, the ingestion of calcium is of no value in promoting hemostasis. Similarly vitamin K is frequently prescribed when a bleeding problem occurs, and it, too, would obviously be of no value unless the bleeding resulted from a prothrombin deficiency. Tainter, Throndson, and Richardson[20, 21] have shown that the commonly recommended systemic hemostatics are not effective and should not be prescribed.

There are systemic hemostatic agents, however, which have specific action and are invaluable in treating certain hemorrhagic disorders. They should be utilized only after a definite diagnosis of a specific disorder has been made by a hematologist or internist. Among the systemic hemostatic agents of value are whole blood transfusions, plasma transfusions, antihemophilic globulin, the antiheparin drugs, vitamin K, and vitamin C.

With the possible exception of whole blood transfusions, it is obvious that these agents are not indicated in the treatment of postoperative hemorrhage of local origin. Whole blood may be indicated if the local hemorrhage has been profuse and of long standing, but with this one exception the systemic hemostatic agents should be reserved for the bleeding problems associated with the hemorrhagic diseases.

Two other systemic agents should be mentioned for the sake of completeness. Adrenosem salicylate has been recommended as a preoperative or postoperative medication to prevent operative and postoperative bleeding. Its action is reported[15] to be due to an increase in capillary resistance. Kutapressin has also been recommended to control hemorrhage and its action depends on a constriction of the terminal arterioles and capillaries. The need for these drugs is rare, but they may prove of value in properly selected instances.

■ *Hemorrhagic Diseases that Predispose to Hemorrhage*

Mention should be made of the hemorrhagic disorders that might lead to serious bleeding in the event oral surgical procedures are attempted. The importance of recognizing these conditions is obvious.

20. Tainter, M. L., and Throndson, A. H. Hemostatic effects of administration of calcium, viosterol, styptose and ceanothyn by mouth. J.A.D.A. & D. Cosmos 25:638 April 1938.

21. Tainter, M. L., Throndson, A. H., and Richardson, A. P. Alleged hemostatic action of gelatin, coagulen, fibrinogen, and histidine administered by mouth. J.A.D.A. 26:420 March 1939.

Since hemostasis depends on a normal vascular system, normal platelets, and a normal coagulating mechanism, deficiencies of any of these factors may lead to abnormal bleeding. Frequently, more than one deficiency is encountered in any particular bleeding problem. The bleeding disorders are often classified according to the type of deficiency present. Complete coverage of these disorders can be found in standard textbooks[2, 4, 5] on hemorrhagic disorders, therefore only the conditions most frequently encountered in dental and oral surgical practices will be considered.

Fig. 2—Soft, friable blood clot in a hemophiliac two weeks after extraction. An oozing type of bleeding continued for an additional two weeks from around the clot. Repeated transfusions of whole blood finally controlled the bleeding

HEMOPHILIA—Hemophilia is a hereditary hemorrhagic disease caused by an alteration in the blood coagulating mechanism. A family history of bleeding in males, with transmission through females, is the usual observation, although sporadic instances do occur. The bleeding defect is a delayed coagulation time with the other factors concerned with hemostasis being normal. It is characterized by prolonged and serious oozing after trauma or surgical procedures, bleeding into various joints of the body, subcutaneous and intramuscular hemorrhage, bleeding from the nose, mouth, gastrointestinal and genitourinary tracts, and hemorrhage into the various body cavities. The disease is encountered in dental practice and must be handled with care. Every surgical procedure on a hemophiliac is a serious operation, as continuous bleeding of an oozing nature may persist for days or even weeks (Fig. 2). This may lead to severe anemia and even death if the hemorrhage is not arrested. Systemic therapy to supply the deficient clotting factor is indicated in all instances. Fresh or stored whole blood, fresh, frozen, or dried plasma, and antihemolytic globulin (Cohn Fraction I) are the agents most frequently employed in the treatment of this condition.[22]

THROMBOCYTOPENIA PURPURA — Thrombocytopenia purpura is a hemorrhagic disorder characterized by a decrease in the number of platelets. At least two forms are recognized — the idiopathic, for which there is no known cause, and the secondary or symptomatic, in which the reduction of platelets is due to a known etiologic agent. Drugs, roentgen ray, radium, and radioactive salts, diseases of the blood and blood forming organs, diseases of the spleen, allergy, and certain systemic diseases are among the agents and conditions that may produce secondary thrombocytopenic purpura.

The decrease in platelets in both varieties of the disease is accompanied by

22. Aggeler, P. M., and Lucia, S. P. Hemorrhagic disorders. Chicago, University of Chicago Press, 1949, p. 34.

increased capillary fragility, increased bleeding time, and diminished clot retraction. The disease is characterized by a steady bleeding from lacerated and contused tissues. Subcutaneous and submucosal ecchymosis, multiple petechial hemorrhages, and a seeping hemorrhage from mucous membranes, particularly of the nose and mouth are frequently seen (Fig. 3). Patients with this disorder present serious management problems, and oral surgical procedures are definitely contraindicated until the disease is under control or the bleeding deficiency has been corrected by systemic therapy.

LEUKEMIA—Bleeding is characteristic of the acute leukemias. Regardless of the type of acute leukemia encountered, a considerable increase in the white cells is seen. This is accompanied by a corresponding decrease in the red blood cells and platelets. The deficiency in platelets actually amounts to a secondary thrombocytopenia and causes a breakdown of the hemostatic mechanism. Furthermore, when infection is a factor, a circulating anticoagulant of bacterial origin[23] may be produced to interfere further with the coagulating process. Spontaneous bleeding from the oral and nasal mucosa, gastrointestinal tract, multiple petechiae, and bleeding into body cavities may be observed in patients with acute leukemia (Fig. 4). It is obvious that surgical procedures in one of these patients would be extremely hazardous and should be undertaken only in cases of extreme emergency.

Bleeding is also a problem in the chronic leukemias. Although the platelets may be decreased in these conditions, bleeding is also noted when normal or elevated platelet counts are present. This is probably due to a qualitative defect in the platelets in which the platelets do not furnish the necessary substances for coagulation.[24]

Fig. 3—Multiple petechial hemorrhages characteristic of thrombocytopenia purpura

POLYCYTHEMIA VERA — In polycythemia vera, which is characterized by a pathologic increase in red blood cells, bleeding tendencies are also seen. Appearance of ecchymosis and hematomas, mucosal bleeding, and unusual bleeding after minor operations are the hemorrhagic defects most commonly seen. The bleeding probably results from a low fibrinogen

23. Freeman, G. Anticoagulant effect of bacterial polysaccharides in normal and thrombocytopenic plasma of leukemia. Blood 7:235 Feb. 1952.

24. Bigelow, F. S. Serotonin activity in blood. J. Lab. & Clin. Med. 43:759 May 1954.

level in the plasma combined with the same type of qualitative deficiency of the platelets as occurs in chronic leukemia. The bleeding tendency in this syndrome responds well to the removal of several pints of the patient's blood and replacement with a comparable amount of normal plasma.[25] This procedure removes part of the excessive red blood cells and supplies fibrinogen.

Fig. 4—Multiple petechiae of oral mucosa in patient with acute myelogenous leukemia

HYPOPROTHROMBINEMIA — Deficiencies in prothrombin will lead to prolonged bleeding. In order to maintain a normal plasma prothrombin level, it is necessary to have a sufficient intake of vitamin K, a normal amount of bile salts in the intestines, and a normal activity of the enzymatic systems of the liver. A deficiency of any of these processes results in a lowered plasma prothrombin level. Since the average diet contains adequate amounts of vitamin K, deficiencies from inadequate intake are rare. However, failure to absorb vitamin K from the intestines may occur. Sprue, celiac disease, biliary obstruction or fistula, and similar diseases, because of their interference with absorption of the fat-soluble vitamins, will produce hypoprothrombinemia. Administration of oral antibiotics and chemotherapeutic agents may also lead to decreased absorption of vitamin K, because these substances destroy the intestinal bacteria that normally synthesize vitamin K from foodstuffs. Failure of the liver to synthesize vitamin K is characteristic of such hepatic diseases as toxic hepatitis, cirrhosis, and acute yellow atrophy of the liver. Bishydroxycoumarin (Dicumarol) and related drugs used in the treatment of cardiac and vascular disease produce a hypoprothrombinemia by competing for the enzyme systems necessary for the synthesis of prothrombin. The salicylates, when taken in large doses for prolonged periods, as frequently seen in arthritics, will similarly interfere with the synthesis of prothrombin. Abnormal bleeding in these patients may be expected when surgical procedures are performed.

Administration of vitamin K has a definite therapeutic effect on the hypoprothrombinemias resulting from an impaired intake or a faulty absorption of vitamin K, but often fails to produce a response when the defect is due to inadequate liver function.[26] As in all the hemorrhagic diseases, patients with bleeding disorders resulting from hypoprothrombinemia present a complicated problem that requires medical management whenever operative procedures are considered necessary.

25. Stefanini, M., and Dameshek, W. The hemorrhagic disorders. New York, Grune & Stratton, 1955, p. 195.
26. Stefanini, M., and Dameshek, W. The hemorrhagic disorders. New York, Grune & Stratton, 1955, p. 174.

BLEEDING RESULTING FROM VASCULAR DEFECTS—Bleeding syndromes resulting from defects in the vascular system may be due to congenital abnormalities of the vessels or to increased permeability or fragility of the vessel walls. The hemorrhagic disorder of particular concern in this group is scurvy. Deficiencies in ascorbic acid result in faulty synthesis of the cementing substance of the capillaries which produces an increased permeability of the vascular walls. Scurvy is rarely encountered today, but when it does occur, it usually involves the oral cavity. It should be considered when a soft "boggy" mucosa with frank gingival hemorrhage is seen.[27] There is usually concomitant bleeding into the skin and the muscle tissues.

Hereditary hemorrhagic telangiectasia (Osler's disease) is also a hemorrhagic disease of vascular origin which is occasionally seen in the oral cavity. It represents a congenital abnormality of the vessel wall and is manifested by spontaneous bleeding from various parts of the body including the nose, lips, tongue, and oral mucosa. It forms visible areas of telangiectasias, and the bleeding episodes tend to recur repeatedly in the same areas. The disease is not difficult to recognize, but it poses many difficult treatment problems.

The hematologists recognize many additional bleeding syndromes and many variations of the ones just listed. For this discussion, however, it is sufficient to call attention to the more common bleeding disorders and again emphasize the importance of a proper preoperative screening of all patients. In this way the patients with abnormal bleeding tendencies will be recognized and can be referred to the proper place for adequate care.

SYSTEMIC CONDITIONS PREDISPOSING TOWARD POSTOPERATIVE HEMORRHAGE—In addition to the hemorrhagic disorders, other systemic diseases may predispose toward postoperative bleeding. Hypertension increases the amount of bleeding at the time of surgery, and because of the added pressure within the vascular system may actually displace the newly formed blood clots. Complete hemostasis at the time of surgery, the use of the absorbable hemostatic sponges, and adequate suturing of the soft tissue will keep postoperative bleeding of this type at a minimum. Advanced anemia may be accompanied by a corresponding decrease in the number of platelets and may possibly result in bleeding tendencies. Hemolytic, obstructive, or infectious jaundice may interfere sufficiently with liver function to produce a hypothrombinemia. The effects of anticoagulant therapy in cardiac and vascular disease have already been mentioned. Gaucher's disease, reticuloendotheliosis, Hodgkin's disease, and multiple myeloma which frequently involve parts of the hematopoietic system may result in a sufficient depression of the blood platelets to create bleeding tendencies. In the same manner, advanced metastatic carcinoma of the skeletal system may suppress the bone marrow sufficiently to make bleeding a problem. The surgeon should be cognizant of the effects of these diseases on the coagulating mechanism, and have a complete evaluation of the bleeding problem in event surgery is necessary.

27. Burket, L. W. Oral medicine, ed. 2. Philadelphia, J. B. Lippincott Co., 1952, p. 346.

■ *Summary*

Postoperative hemorrhage is a complication that most dentists will face at some time during their professional careers. Therefore, knowledge of the physiology of hemostasis and the cause of hemorrhage is essential.

Although the majority of postoperative bleeding problems will be of local origin and will occur in patients with a normal coagulation mechanism, the dentist should be on the alert constantly for the occasional patient who has one of the systemic hemorrhagic disorders.

A step by step procedure for the control of postoperative hemorrhage of local origin has been given, as well as the prophylactic measures to prevent this complication. Every dentist should have a method of screening patients to recognize those with systemic bleeding disorders; particularly, he should be aware of the need for taking an adequate history so as to be able to evaluate the condition of the patient.

Patients with abnormal bleeding conditions who require oral surgical treatment should be treated in a hospital where adequate facilities and personnel are available to cope with any problem that might arise.

■ How Flowers Changed the World

Judging by modern standards, the world in which flowers first appeared was a world in slow motion, a cold-blooded world whose occupants were most active at noonday but torpid on chill nights, their brains damped by a slower metabolism than any known to even the most primitive of warm-blooded animals today. A high metabolic rate and the maintenance of a constant body temperature are supreme achievements in the evolution of life. A high metabolic rate, however, means a heavy intake of energy in order to sustain body warmth and efficiency. The agile brain of the warm-blooded birds and mammals demands a high oxygen consumption and food in concentrated forms, or the creatures cannot long sustain themselves. It was the rise of the flowering plants that provided that energy. Without them, the world we know—even man himself—would never have existed.—*Loren Eiseley. The Immense Journey, 1957.*

VOLUME 16 • MARCH 1958 • NUMBER 2

CASE REPORTS

Chronic osteomyelitis of the mandible: *report of case*

■ *Richard L. Verbic,* D.D.S., M.S.D., and Sunder J. Vazirani,† D.D.S., Chicago*

Since the advent of the use of antibiotics to prevent and combat bacterial disease, classic instances of osteomyelitis of the jaws are seldom seen. Continued research on new antibiotics may lead the way for virtual extinction of the types of osteomyelitis that have led so often to pathetic deformities of the jaws.

Osteomyelitis is a progressive inflammation of bone, that affects the marrow content initially, and later spreads to the bone itself.[1] Limitation of the process does not occur, because no pyogenic membrane is formed. Thoma[2] has stated that odontogenic infections are the most common local causes of osteomyelitis; this type of infection may remain localized or may involve a large part of the bone.

Staphylococcus pyogenes var. *aureus* is the main organism responsible for the majority of instances of osteomyelitis; more rarely *Staphylococcus pyogenes* var. *albus* may cause the disease. Osteomyelitis may be acute, subacute, or chronic, and may terminate in various ways. The infection, after proper treatment, may never recur. The following case is reported to show an example of chronic osteomyelitis of the mandible that pursued a chronic course with multiple fistulas over a period of five years.

CHIEF COMPLAINT—A 70 year old negro man was referred to the oral surgery clinic of the University of Illinois Research and Educational Hospitals for diagnosis and treatment of a swelling in the lower left first molar region. The patient was seen initially on September 3, 1955.

ONSET AND COURSE—In 1939, the patient stated, he had had all his teeth removed under local anesthesia, with the exception of the lower right and left third molars. A diagnosis of periodontitis had been made. An upper complete denture and lower partial denture were constructed at that time. After the insertion of the prosthetic appliances and for frequent periods after, the patient experienced pain accompanied by recurrent swelling in the lower left mandibular region. On several occasions the swelling would spontaneously open up, and relief from the pain was then experienced. Consultation with his dentist followed on several occasions, but no treatment was instituted.

In April 1951, the patient first complained of pain in the lower left molar region. The examination at that time revealed the presence of the lower right and left third molars. The patient was wearing a complete upper denture, but was unable to wear his lower partial denture because of soreness in the lower left molar region. Roentgenograms made in April 1951 revealed a "slight area of erosion" in the lower left first molar region (see illustration, above left). Treatment rendered at that time con-

From the division of oral surgery, University of Illinois, Research and Educational Hospitals.

*Attending staff, hospital oral surgery, Research and Educational Hospitals.

†Chief resident in oral surgery, Research and Educational Hospitals.

1. Bernier, J. L. Manual for the differential diagnosis of oral lesions. St. Louis, C. V. Mosby Co., 1942, p. 122, 123.

2. Thoma, K. H. Oral surgery, vol. 1, ed. 2. St. Louis, C. V. Mosby Co., 1952, p. 779-858.

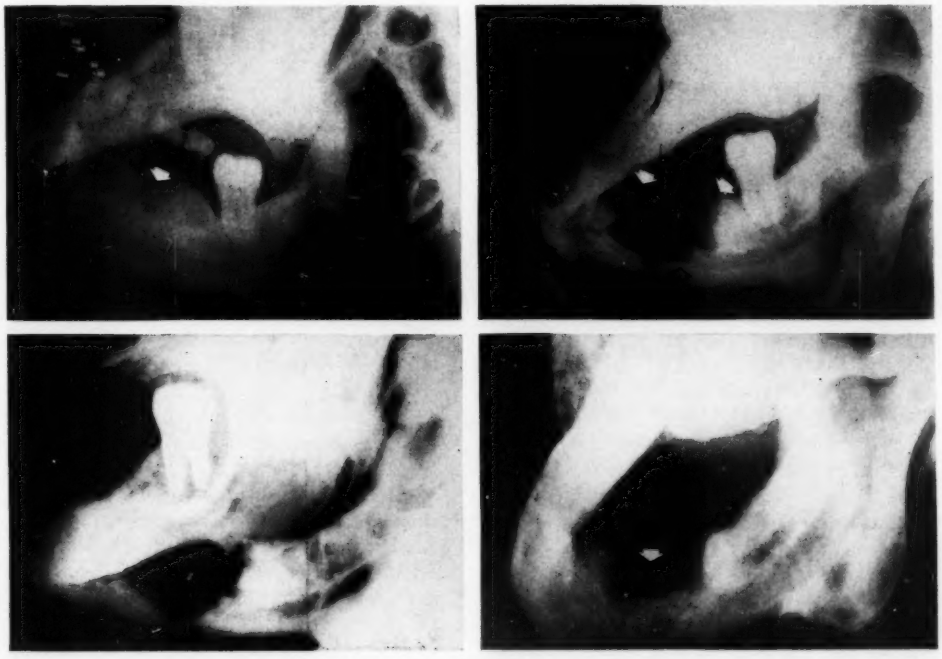
sisted of irrigation of the lower left molar region with benzalkonium chloride solution.

GENERAL EXAMINATION—The complete history and physical examination was noncontributory with the exception of a history of gonorrhea in 1903 that had been treated in the Army.

REGIONAL EXAMINATION—Oral examination revealed a localized, fluctuant swelling in the left mandibular ridge region, measuring approximately 2.5 cm. The lower left third molar was loose, although not painful to percussion. The swelling was soft and fluctuant, and the overlying mucosa was thick and keratotic with negroid pigmentation. There were multiple sinus openings from which a thick purulent discharge could be expressed. Tenderness and pain were noted on digital examination. No cervical nodes were palpable. The examination of the remainder of the oral cavity was essentially negative.

LABORATORY EXAMINATION—The hemoglobin was 13.5 Gm. per hundred cubic centimeters; the white blood cell count was 5,050, with lymphocytes 43 per hundred; the sedimentation rate (Wintrobe) was 32. The urinalysis was normal with a specific gravity of 1.010. The Wassermann and Kahn tests were negative. The bacteriologic culture of the purulent discharge contained abundant *Staphylococcus pyogenes* var. *aureus*, alpha streptococci, Neisseria and a few micrococci.

ROENTGENOGRAPHIC EXAMINATION — Roentgenograms of the mandible showed a



Views of patient. Above left: Roentgenogram in April 1951 revealed slight area of erosion in left molar region of mandible. Above right: Roentgenogram taken on September 3, 1955, showing large, irregular defect with considerable destruction of alveolar process in left first and second molar regions. Below left: Postoperative view in October 1955. Note area of surgical defect. Below right: Roentgenogram one year after surgery, November 1956, shows fair amount of bone regeneration and immature bone density

large, irregular defect with considerable destruction of the alveolar process in the left first and second molar regions, extending to and involving the inferior alveolar canal. The inferior border of the mandible was intact, and no evidence of pathologic fracture was noted. Multiple sequestrums were noted within the radiolucent area (see illustration, above right).

TENTATIVE DIAGNOSIS — The tentative diagnosis was low-grade, chronic osteomyelitis of the mandible. In differential diagnosis, luetic osteomyelitis, actinomycosis and metastatic carcinoma were considered.

TREATMENT AND COURSE—On October 20, 1955, under local anesthesia, an incision was made over the left alveolar ridge and extended from the cuspid region to the left molar region. The lingual and buccal mucosae were reflected and retracted, and the mandibular defect was revealed. The cavity was found to be filled with necrotic granulation tissue and sequestrums. Considerable pus was present.

The defect was débrided and saucerized, and the loose third molar was extracted. The mandibular nerve and vessels were identified in the posteroinferior end of the defect. Considerable bleeding was experienced, and hemostasis was obtained by using epinephrine 1:1,000 on gauze packs. The large defect was covered with mucoperiosteum sutured with no. 0000 nylon. An oral pressure dressing was used. The postoperative roentgenograms taken on the day of operation revealed the site of the surgical defect in the body of the mandible (see illustration, below left).

The postoperative treatment consisted of bed rest, ½ grains codeine every four hours for pain, a high-protein liquid diet, an ice pack to the outside of the face and warm saline rinses. The patient was seen on the fourth postoperative day. He experienced a considerable amount of swelling, although the pain symptoms were slight. Sensory nerve supply to the lower lip was normal. The intraoral sutures were removed on the seventh day, and the wound appeared to be healing by first intention.

The patient then was discharged from the clinic. Postoperative roentgenograms were taken in January 1956, three months after surgery. The patient was seen again in November, which was one year after surgery. The clinical and roentgenographic examination disclosed moderate bone regeneration (see illustration, below right) and no evidence of recurrence of the osteomyelitis. He was advised to see his private dentist for construction of a lower denture and was instructed to return for observation in one year.

PATHOLOGIC FINDINGS—The microscopic description of the specimen was as follows:

"Soft tissue sections reveal masses of necrotic tissue. One fragment reveals a long epithelial ridge extending into the lamina propria. This is essentially granulation tissue. A few polymorphonuclear neutrophils are noted. However, lymphocytes and plasma cells are present in large numbers.

"The second section consists of bone and dense connective tissue only. The dense connective tissue is composed of interlacing bundles of collagenous fibers. Some appear fragmented, swollen and separated. The bone is mature and laminated. Osteocytes are present in the lacunas. There is evidence of previous resorption, but little active resorption is evident at this time. The marrow spaces are filled with a fibrous, cellular marrow. Few inflammatory cells are noted."

DIAGNOSIS—"Granulation tissue compatible with low-grade chronic osteomyelitis."

DISCUSSION—Chronic osteomyelitis of long standing necessitates the excision of the necrotic portion of the bone. The removal of the nonvital bone through an adequate surgical incision is followed by saucerization of the defect. Saucerization removes the overhanging bony edges of the wound and facilitates closure of the wound by the tissues in order to obliterate the defect.

The combination of prompt diagnosis, good surgical treatment and the intelligent use of antibiotics is necessary to treat chronic osteomyelitis effectively.

Peripheral odontogenic fibroma with cementogenesis: *report of case*

■ *Norman Buckman, D.D.S., Bethesda, Md.*

Gingival fibromas are common oral lesions and constitute 2 per cent of all growths found in the oral cavity.[1] As they may arise from periosteum or periodontal membrane, calcifications are often noted in the fibrous connective tissue stroma. The following case report illustrates an unusually large gingival fibroma containing considerable cementum.

REPORT OF CASE—A 55 year old Navajo Indian woman was admitted to the dental service of the Fort Defiance Indian Hospital, Fort Defiance, Ariz., on April 1, 1956, for excision of a large gingival tumor in the anterior part of the mandible. Her only complaint was that it had become slightly tender recently.

The past medical history revealed that a gingival mass, located between the lower incisors, had been removed in 1940. The histopathological diagnosis of this tissue was chronic hypertrophic gingivitis. Approximately one year after surgery, the mass recurred. Initially the rate of growth was slow, but two years prior to this admission the growth had greatly accelerated.

On intraoral examination, a relatively hard mass was seen arising from the labiogingival region of the mandibular incisor region extending from the right mandibular cuspid to the region of the left lateral incisor (Fig. 1). The lower anterior teeth were enveloped completely by the mass folding over the teeth in its lingual extension. A tooth, covered with calculus, was embedded in the lingual aspect of the tumor. The mass was not ulcerated or hemorrhagic. Patchy reddened areas, however, were sharply demarcated from the over-all pale pink appearance. The lesion was sessile and could be moved slightly in a labiolingual direction. The patient used the incisal table of the mass as a masticatory platform.

Her remaining teeth were in poor condition with many residual roots embedded in granulation tissue. Advanced periodontal disease was apparent.

The laboratory and remainder of the physical examinations did not reveal any abnormalities. Cervicofacial lymphadenopathy was not present.

Roentgenographic examination revealed a radiopaque center within the lesion. The underlying cortical bone did not appear to be disturbed by the mass. The teeth beneath the tumor were considerably displaced, with two exfoliated anterior teeth lying horizontally in the mass (Fig. 2).

On April 5, the tumor was excised. In attempting to dissect the lesion free from its base, considerable hemorrhage was encountered. To assist in controlling this hemorrhage, electric cutting and coagulating currents were used. All the displaced anterior teeth were loosely attached to the tumor. The right central incisor was completely displaced out of the alveolus in a labial direction and the right cuspid, similarly, in a lingual direction. The tumor seemed to arise on the labial aspect of the alveolar ridge.

After a wide excision of the mass, the remaining lower incisors and the lower right cuspid, bicuspids and first molar were extracted. A previously prepared clear acrylic splint, filled with surgical cement, was inserted over the operative site. The postoperative course was uneventful. Figure 3 shows the lower alveolar ridge five weeks after surgery. As the patient

Senior assistant dental surgeon, U. S. Public Health Service, Clinical Center, National Institutes of Health.

Fig. 1—Gingival tumor of mandible

subsequently moved away from the vicinity, further follow-up was not possible.

The gross specimen measured 3.5 by 3.0 by 2.5 cm. and resisted sectioning by a knife. The histopathological report, prepared by Harold R. Stanley, Jr., oral pathologist, National Institute of Dental Research, follows:

"The specimen consists of an oval shaped mass of predominantly dense, collagenous, acellular, avascular fibrous tissue. Within this mass is an irregular, trabeculated, calcified body of similar shape. Atrophic epithelium sporadically outlines the fibrous mass, but on one surface the epithelium becomes relatively acanthotic, hyperplastic and parakeratinized. The outermost periphery, as well as the tissue filling the spaces between the trabeculae, reveals a more cellular and less collagenous fibrous tissue containing many various sized vascular channels. Inflammation is minimal.

"The calcified portion of the lesion consists of a matted network of generally robust, thick trabeculae with a prominent mosaic pattern created by the extreme irregularity of incremental growth lines. The texture and stainability is more compatible with cementum rather than bone. Cementoid is present, but is slight in amount as compared to the over-all size of the calcified mass. No cementoclastic activity is observed. Mitoses are not found. There is no evidence of malignancy.

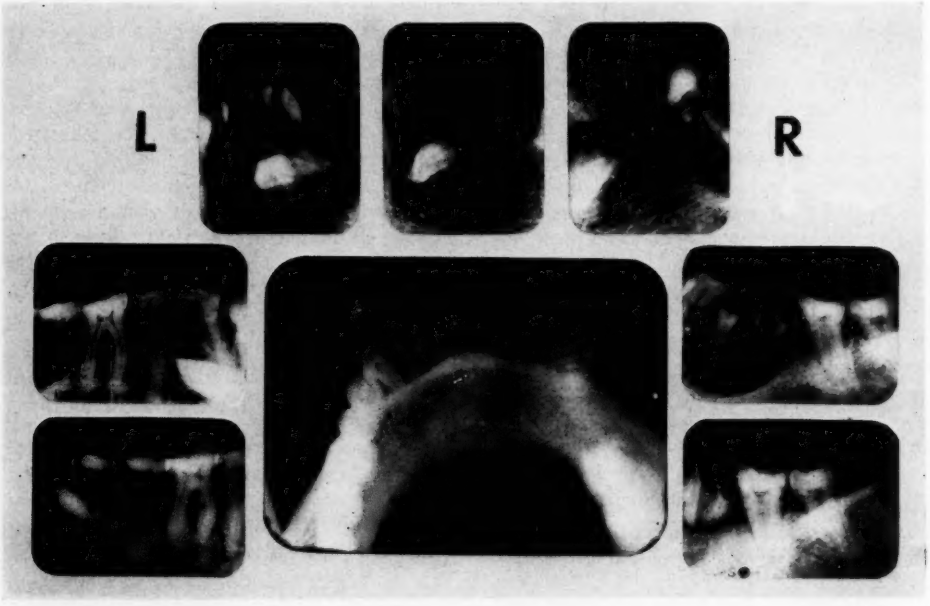


Fig. 2—Mandibular teeth, showing relationship of mass to teeth

"Diagnosis: peripheral odontogenic fibroma with cementogenesis; gingiva, mandible."

Figure 4 illustrates the microscopic features of this tumor.

DISCUSSION — Descriptions of gingival tumors have often been confused by the inconsistency of terminology. Such terms as "epulis," "fibrous epulis," "ossifying fibroma," "peripheral odontogenic fibroma" and "ossifying fibroid epulis" have been used by various authors to describe essentially the same lesion.

"Epulis" is a topographical term meaning, literally, a growth on the gingiva. From a histopathological analysis, there are many different types of epulides. The following classification of gingival tumors has been adapted from Bernick:[1]

Epulis

A. Inflammatory growths
   1. Chronic inflammatory hypertrophy
   2. Pyogenic granuloma

B. Connective tissue tumors
   1. Benign
      a. Fibroma
      b. Giant cell tumor
      c. Angioma
      d. Lipoma
      e. Myxoma
   2. Malignant
      a. Sarcoma
      b. Melanoma

C. Epithelial tissue tumors
   1. Benign
      a. Papilloma
      b. Adenoma

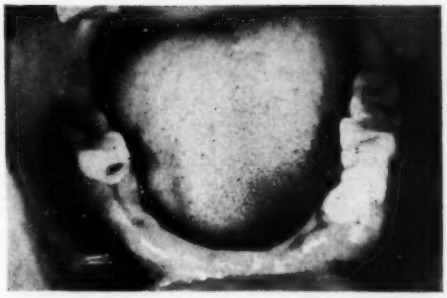


Fig. 3—Mandibular alveolar ridge five weeks after surgery

1. Bernick, S. Growths of the gingiva and palate. 1. Chronic inflammatory lesions. Oral Surg., Oral Med. & Oral Path. 1:1029 Nov. 1948.

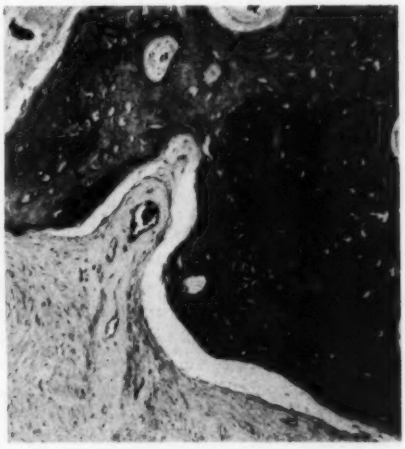


Fig. 4—Left: Cross-section view of peripheral odontogenic fibroma. Right: Cementum trabecula within tumor

2. Malignant
   a. Carcinoma

D. Mixed tumors

Epulides, therefore, may be either inflammatory tissue, connective tissue, epithelial tissue, or any combination of these.

Bernier terms the gingival fibroma a "peripheral odontogenic fibroma," a more definitive term. This nomenclature is explained by his following statement:[2] "The odontogenic fibroma is nothing more than the ordinary fibroma arising from fibrous connective tissue of the periodontium with a demonstration of the added odontogenic potential of that tissue. This is seen in the product formation of bone, cementum, and other calcified tissues."

Since the only active cementogenic tissue in the body is the periodontal membrane, the tumor in the case reported apparently arose from the periodontal membrane of the lower anterior teeth. Calcifications occurring in peripheral odontogenic fibromas are well appreciated, with many instances documented.[3-6]

The type of calcification is dependent on the degree of differentiation and area of periodontal membrane involved in this change.[7] Thus, there may be nonspecific amorphous calcifications, bone spicules, well-defined bone, cementicles, and cementum, singly or in combination. Isolated areas of amorphous calcifications are most apt to be present. Well-defined cementum, however, is uncommon.[2] It is interesting to note that the central counterpart, the periapical odontogenic fibroma, frequently contains cementum as a dominant feature.[8]

Review of the literature reveals that Rywkind[9] first mentioned the presence of cementicles in a paper published in 1930. He reported a "fibrous epulis" containing large numbers of cementicles and bony spicules. Stafne[10] published a print of a roentgenogram of a "fibrous epulis" also containing cementicles and bone spicules. In 1951, Stafne[11] further reported a peripheral fibroma containing cementum, located in the edentulous lower right first molar space and measuring 2.5 by 2.0 by 1.5 cm. This was the first such lesion reported to have conspicuous cementum formation.

Bruce[12] stated that calcifications are more often present than is ordinarily expected, especially in long-standing fibromas. In his microscopic examination of a number of these gingival fibromas, he found a high incidence of amorphous calcification, bone, cementum and various admixtures of these. Bernier[2] and Thoma[8] also have written that cementum may occur. It is reasonable to assume that there exists a higher incidence of cementum in peripheral odontogenic fibromas than has been reported. Undoubtedly, cementum has often been confused with bone in these lesions. Cementum can be differentiated from bone, however, by the noticeable irregularity of incremental growth lines, scarcity of embedded cementocytes, and absence of haversian systems and Volkmann's canals. In cementum, the lacunas are more oval, with fewer canaliculi. These canaliculi extend in only one direction, rather than radially about the entire lacuna.[2]

CONCLUSION—This report illustrates the presence of prominent trabeculae of cementum in a massive gingival fibroma of about 15 years' duration. Although on a histological basis it might be expected that cementum would be found in many of these lesions, only a few such instances have been documented. The size, presence of cementum and long-standing nature of this peripheral odontogenic fibroma make it of interest.

2. Bernier, J. L. Management of oral disease. St. Louis, C. V. Mosby Co., 1955.

3. Anderson, B. G. Epulis; series of cases. Arch. Surg. 38:1030 June 1939.

4. Ennis, L. M., and Berry, H. M., Jr. Ossifying periapical fibroma: roentgenologic studies. J.A.D.A. 37:642 Dec. 1948.

5. Cahn, L. R. Pathology of the oral cavity. Baltimore, Williams and Wilkins Co., 1941.

6. Bernier, J. L. Oral diseases and tumors complicating periodontal diagnosis and treatment. J.A.D.A. 39:25 July 1949.

7. Bernier, J. L. Differential diagnosis of oral lesions. 1. Benign oral tumors. Oral Surg., Oral Med. & Oral Path. 2:617 May 1949.

8. Thoma, K. H. Oral pathology, ed. 4. St. Louis, C. V. Mosby Co., 1954.

9. Rywkind, A. W. Zur Frage der Zementikelbildung. Zschr. Stomatol. 28:1178 Dec. 1930.

10. Stafne, E. C. Periapical fibroma: roentgenologic observations. J.A.D.A. 30:688 May 1943.

11. Stafne, E. C. Peripheral fibroma (epulis) that contains a cementum-like substance. Oral Surg., Oral Med. & Oral Path. 4:463 April 1951.

12. Bruce, K. W. Peripheral fibroma of the gingiva with osteogenesis. D. Items Interest 75:1065 Dec. 1953.

Mixed tumor in an eight year old child: *report of case*

■ *George Stinson,* D.D.S., and Robert I. Scileppi,† D.D.S., Brooklyn, N. Y.*

Mixed tumors of the salivary gland type involve particularly the major salivary glands, but may form from the mucous glands in the palate, the lips, or the buccal mucosa. Cordray,[1] in a study of 61 cases, reported seven instances of mixed tumors of the palate. This type of tumor occurs most frequently in the age group from 40 to 60, although a few instances have been reported in the literature as occurring in patients as early as the first decade of life.

REPORT OF CASE—On January 13, 1955, an eight year old negro boy was referred to the department of dental and oral surgery, Kings County Hospital, by the school dentist. The boy's chief complaint was a swelling of the palate to the left of the midline.

HISTORY—The patient stated he had been aware of the swelling for approximately six months, and had noted an increase in size in the past month. He had experienced no pain or discomfort. Both the past history and family history were noncontributory.

The general physical condition of the patient was good. His heart and lungs were normal and no recent pulmonary or pleural pathologic conditions were reported. The blood pressure was 122/84, pulse 84, and respiration 24. Laboratory examinations showed hemoglobin, 20 Gm. and white blood cell count, 8,300. Urinalysis showed albumin, plus 1, glucose and acetone, negative.

CLINICAL AND ROENTGENOGRAPHIC EXAMINATIONS—Clinical examination revealed a raised mass in the palate to the left of the midline, extending from the deciduous cuspid to the deciduous first and second molars. The lesion was soft to palpation, reddish blue in color, and appeared to be cystic in nature. All other components of the oral cavity were clinically normal (Fig. 1, above left).

Routine roentgenographic examination of the lesions (periapical and occlusal intraoral films, and an extraoral Waters' sinus view) revealed a radiolucent area approximately the size of a walnut, in the hard palate in the maxillary left deciduous cuspid and molar area. Periapical films were of little value in locating the lesion; because of the mixed dentition, however, occlusal films were of great value (Fig. 1, above right). The clinical impression at this time was that the lesion was a dentigerous cyst.

OPERATIVE PROCEDURE—Because of the age of the patient, it was decided that the conservative approach would be used. The region circumscribing the lesion was infiltrated with 2 per cent lidocaine. Under this anesthetic, a 15 gauge needle was introduced into the lesion in an attempt to aspirate cystic fluid. No fluid was obtained; the lesion was extremely vascular and bled freely. Bleeding was controlled by pressure.

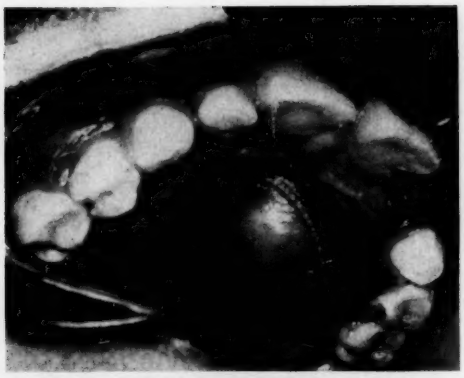
After a reappraisal of the situation, it was decided that a biopsy specimen should be taken of the lesion. This was done, and the specimen sent to the pathologist with an indicated diagnosis of ameloblastoma or mixed salivary tumor. The pathologist reported that the lesion was a mixed tumor of minor salivary gland.

OPERATIVE PROCEDURE—In view of the pathologist's report, it was decided that wide excision of the tumor was advisable. After pre-

*Chief of service, department of oral surgery, Kings County Hospital.

†Assistant resident, department of oral surgery, Kings County Hospital.

1. Cordray, D. P. Mixed tumors of region of the head. Arch. Otolaryng. 49:631 June 1949.



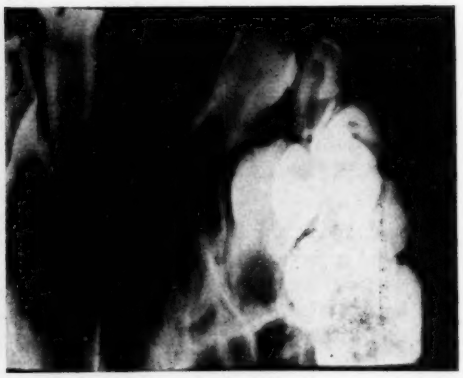


Fig. 1—Above left: Intraoral view of tumor mass in hard palate extending from upper left deciduous cuspid posteriorly to second deciduous molar and medially to midline. Above right: Occlusal view. Radiolucent area presents picture of dentigerous cyst. Left: Enucleated mass, with dense, well defined capsule

Fig. 2—High power photomicrograph showing irregular clefts lined by fairly uniform type of cuboidal epithelium, with large regular nuclei. No anaplasia can be seen, the matrix is uniform and contains scattered fibroblasts in an eosinophilic stroma

medication with phenobarbital, 50 mg., the patient was brought to the oral surgery clinic, and the palatal and buccal surfaces were infiltrated with 2 per cent lidocaine. Under this anesthesia, a circular incision was made approximately 7 to 8 mm. from the border of the tumor. Since the maxillary left deciduous cuspid and first and second deciduous molars were within the confines of this region, it was decided to extract these teeth so that complete excision could be attained. The mass was well encapsulated and was enucleated with ease (Fig. 1, below). There was no apparent invasion of the underlying bone which was curetted as a precautionary measure. The void was packed with a paste of zinc oxide, eugenol, and oxytetracycline, 250 mg.

The specimen was sent to a pathologist.

POSTOPERATIVE COURSE—The patient remained in the hospital and was seen daily. After an uneventful period of ten days in which the patient remained afebrile and experienced no pain or discomfort, he was discharged and was seen at weekly intervals. After three weeks the packing began to fall out and the wound was granulating nicely. After six weeks the packing came out completely, and after eight weeks the region was fully healed.

The pathologist's final report confirmed the diagnosis of mixed tumor of minor salivary gland (Fig. 2).

DISCUSSION — Although mixed salivary tumors are generally found in patients after the fourth decade of life, they may occur in any age group. When this type of lesion occurs in the younger patient with a mixed dentition, it is easy to make a faulty diagnosis of dentigerous cyst.

In general, mixed salivary tumors can be classified as benign, malignant, or locally malignant or recurrent. Since they are extremely resistant to radiation therapy, the treatment of choice in instances of mixed salivary tumors is wide excision and postoperative observation.

■ Problems of the Scientist

Scientific research is conducted largely behind closed doors, and the accuracy of any man's observations and the veracity of his reports depend ultimately upon his honesty. This honesty depends in turn upon maturity, upon some degree of security, and upon a sense of identification and fellowship with competitors. Under present conditions it is a tribute to scientists that violations of their code of honor are so rare that when lapses occur they become historic scandals. This issue is especially delicate in such fields of science as psychology, psychiatry, and psychoanalysis, in which it is difficult to repeat another man's observations for purposes of objective clinical or experimental or statistical confirmation. Consequently in these disciplines, reports of observations become themselves sources of controversy and suspicion. For many reasons I suspect (although I cannot prove this) that we may be seeing today the birth of a new psychosocial ailment among scientists, one which may not be wholly unrelated to the gangster tradition of dead-end kids.

Are we witnessing the development of a generation of hardened, cynical, amoral, embittered, disillusioned, young scientists? If so, for the present the fashioning of implements of destruction offers a convenient outlet for their destructive feelings; but the fault will be ours and not theirs if this tendency should increase through the coming years and should find even more disastrous channels of expression.

Certainly the idyllic picture of the innocent, childlike scientist who lives a life of simple, secure, peaceful, dignified contemplation has become an unreal fantasy. Instead, the emotional stresses of his career have increased to a point where only men of exceptional emotional maturity and stability can stand up to them for long, and remain clear-headed and generous-hearted under such psychologically unhygienic conditions. Thoughtful educators are beginning to realize that the socio-economic basis of the life of the scientist must be entirely overhauled; that the psychological setting of his life needs drastic revision; and that at the same time the emotional preparation for a life of research is at least as important as is the intellectual training.—*Lawrence S. Kubie, "Some Unsolved Problems of a Scientific Career," American Scientist 42:112 January 1954.*

VOLUME 16 • MARCH 1958 • NUMBER 2

Progress in exodontics

THE CURRENT ISSUE of the JOURNAL OF ORAL SURGERY is devoted to the subject of exodontics, primarily to bring our readers up to date regarding the current advances in this field of dentistry. It is of importance to note that the progress that has taken place during the past 20 years in this area is as significant and widespread as it is in any branch of the healing arts.

All the accomplishments and advances cannot be listed easily, but most of them can be credited directly or indirectly to the development of antibiotics, vastly improved general and local anesthetics and technics, and easy rapid replacement of blood loss by transfusion. Individually or collectively, these three basic contributions have made possible many of the refinements that are recognized in the field of oral surgery today. Removal of impacted teeth without the necessity of prolonged dressing of the wound or the fear of postoperative infection, transplantation of teeth, insertion of bone grafts and bone chips to re-establish contour of the alveolar ridge, intraoral plastic procedures to aid in prosthetic reconstruction, a sensible margin of safety in exodontics for cardiac patients or other debilitated persons, management of the dental problems of the hemophiliac and the prevention of subacute bacterial endocarditis are examples of this, since all have a great dependence on one of the three already mentioned basic contributions.

Despite the vast importance of the progress that has been made, oral surgeons cannot depend on these refinements as a substitute for good surgical ability and judgment. Postoperative infections still may occur occasionally, many patients still have a difficult time during anesthesia and, tragically, a few even fail to survive the experience; other patients may develop serious or fatal reactions to the transfusion of blood. It is obvious, therefore, that proper utilization of new medications and technics is dependent to a great degree on good basic and clinical education.

The progress made in the past 20 years has been tremendous. It has indeed been a golden age of steady advancement. However, careful analysis of the progress attained emphasizes the need for accelerated clinical and basic research. Solution of today's problems points out the necessity of focusing our attention on those of tomorrow, of which there will always be a generous supply.—*Fred A. Henny.*

■ Blood Studies and Dental Patients

Q.—Under what circumstances is it advisable to secure blood studies on dental patients?

A.—All patients admitted to a hospital should have routine blood studies as part of their hospital records. There are certain occasions on which the ambulatory patient should have various blood studies. Without listing the type of studies which would necessitate extensive discussion, some of the conditions which warrant further evaluation are listed: (1) spontaneous hemorrhage from the gingivae and adjacent mucous membranes which is persistent; (2) numerous petechiae of the oral mucosa; (3) postoperative hemorrhage which is not controlled by suturing or by mild hemostatic agents; (4) extreme pallor of the gingivae and mucous membrane; (5) chronic necrotizing ulcerative stomatitis which does not respond to the accepted methods of treatment; (6) atrophy of the papillae of the tongue; (7) persistent soreness and burning tongue in the absence of other findings; (8) a history of prolonged bleeding after previous surgery or evidence of frequent bruising, and (9) a history of liver disease or clinical evidence of jaundice.

■ Behavior of Pericoronal Abscess

Q.—It has been noted in several instances that the presence of pericoronal abscesses near the mandibular third molars often are manifested first by swelling and discharge of pus forward in the buccal vestibule in the region of the first or second molars. What is the explanation?

A.—The spread of pus from pericoronal abscesses is guided by the relative position of the buccinator muscle. The submucous connective tissue in the region of the mandibular third molar is dense, although it is thin in comparison with the tissue near the first and second molars, where thicker layers of loose connective tissue exist. This combination of buccinator muscle attachment and relatively loose submucosa produces a natural region for pooling of exudate arising from the third molar region, and, of course, accurate differential diagnosis of the origin of the exudate is mandatory so as not to condemn erroneously a first or second molar as causing the exudate.

■ Papillary Hyperplasia under Maxillary Dentures

Q.—Is treatment necessary for the papillary hyperplasia seen under maxillary dentures? If so, how should the condition be treated?

A.—This condition is characterized by multiple papillary projections arising from the mucosa of the denture-bearing surface of the palate. The changes noted are an inflammatory response to irritation from the denture. Superimposed bacterial, viral and fungal infections are frequent and often are associated with this condition. Obviously, treatment should be considered necessary for such conditions.

It is generally agreed that since dentures are the important causative factor in these instances, they should be removed if practical for varying periods. Improvement of the condition is the rule when this is done and strict hygiene is followed. However, the condition is not always cured by removal of irritating appliances,

This section devoted to queries and comments from readers on topics of current interest to oral surgeons and general dental practitioners is edited by S. Elmer Bear, Department of Oral Surgery, Medical College of Virginia, Richmond, Va., to whom readers are invited to send their communications. The answers, prepared by competent consultants, do not necessarily represent the opinions of any official scientific organization. Your participation in this section is invited.

The Editor.

and thus, early in treatment, the need for antibacterial or antifungal therapy must be considered. With control of microorganisms established, if the condition persists, surgical correction should be employed. Usually the regions involved are large enough to make excision impractical. In such instances electrosurgery is probably the method of choice.

If preferred, a shaving technic with a scalpel or a rotary instrument may be used successfully in the dental handpiece. If these methods are employed, the bleeding is controlled by the use of a pressure dressing under a palatal splint or the patient's old denture which is relined with a sedative dressing.

As with all instances in which abnormal tissue is removed, it is wise to submit a representative section for histopathologic examination. Though the lesion discussed here is considered inflammatory rather than neoplastic, there is sufficient evidence that the lesion is of the premalignant class, and there are reports of neoplastic changes in a few instances.

■ Bleeding from Inferior Alveolar Artery

Q.—In severe fractures of the region of the mandible with concomitant severance of the inferior alveolar artery, into what regions might there be extensive bleeding? What measures should be taken to control this bleeding?

A.—Spontaneous bleeding from the inferior alveolar artery is generally self-limiting because of constriction of this artery and back pressure of moderate bleeding into the soft tissues. On occasion, however, there will be extensive hemorrhage when the displacement is extreme and the adjacent tissues are sufficiently traumatized. If the bleeding is prolonged, it is possible for the following regions to be involved:

1. The hemorrhage may extend posteriorly beneath the masseter muscle, then along the sternocleidomastoid muscle and under the trapezius muscle. When this occurs, there will be an invasion of the deeper fascial planes of the neck to the region of the supraclavicular region.

2. On the medial aspect bleeding can extend posteriorly along or through the internal pterygoid muscle adjacent to the superior constrictor muscle into the lateral pharyngeal region.

3. Inferiorly the blood may be trapped beneath the mylohyoid muscle in the submaxillary region causing distention of the lateral part of the neck and elevation of the floor of the mouth.

4. The mediastinum may become involved when bleeding persists by extending posterior and inferior to the mandible into the region of the carotid sheath and spreading along this plane inferiorly.

5. On occasion there may be lateral bleeding which extends over the cheek region through the buccinator space passing between the border of the masseter muscle and the posterior lateral surface of the buccinator muscle.

The treatment is as follows: When teeth are present, the most expedient method of controlling this spontaneous hemorrhage is immobilization with intermaxillary appliances if only on a temporary basis. When the mandible is edentulous, the hemorrhage should be controlled with a pressure dressing which should be applied with a Barton bandage and an attempt should be made to compensate for some of the extensive displacement of the fragments.

Should these measures fail and the bleeding persist to the point of causing respiratory embarrassment or severe blood loss, it might be necessary to ligate the external carotid artery. This is done by making an incision approximately 1.5 cm. below and posterior to the angle of the mandible following along the anterior border of the sternocleidomastoid muscle. The subcutaneous tissues are separated to expose the border of this muscle, which is then retracted posteriorly to expose the common carotid artery. The exterior carotid artery is located above the bifurcation of the common carotid. The superior thyroid, external maxillary and lingual arteries, which are branches of the external carotid, should be identified and the ligation made above these branches. On occasion, the lingual and external maxillary arteries arise from the external carotid artery in a common branch.

■ Surgery of Head and Neck Tumors. By Martin D. Hayes. 430 pages with 599 illustrations. Index. Appendix. $18.50. New York, Harper & Brothers, 1957.

An entirely new book in the field of head and neck surgery, authored by a distinguished surgeon of vast clinical experience, *Surgery of Head and Neck Tumors* is an excellent text which will be utilized extensively by everyone interested in the diagnosis and treatment of tumors occurring in this location.

The book is divided in two parts, the first consisting of an organized discussion of the preoperative considerations, technicalities of surgery, postoperative care, operative risk involved in sacrificing various anatomic structures during surgery, and complications and disabilities associated with surgery. This portion of the book contains 115 pages including a comprehensive bibliography. Part 2, consisting of 296 pages, is an atlas of operative procedures which is generously illustrated with a total of 520 line drawings. The quality of the drawings is excellent. The atlas contains all possible procedures for removal of various types of tumors from various locations in the head and neck. Excision of all mouth and jaw tumors is well presented and consists primarily of the present technics employed by the staff of the head and neck service of Memorial Hospital in New York. Oral surgeons will find the procedures outlined of interest and doubtless will use the text as a ready reference for some of the procedures outlined in the atlas.

Appendix A consists of complete instrument lists for the various operations that are described in the text. Appendix B is the resident's operative report including indexing of the diseases and operations. Appendix C illustrates the methods used for photographic control of surgical drawings as employed at the Memorial Hospital.

Everything considered, *Surgery of Head and Neck Tumors* is an outstanding book. It is judged so because of its thorough and candid approach to surgical problems arising in this field, because of its rich use of illustrations and because of the simple, clear style which is employed throughout. All surgeons interested in the field should include *Surgery of Head and Neck Tumors* in their personal libraries.—*Fred A. Henny.*

■ Dental Assistant (No. 15 on a List of American Occupation Monographs). By Leroy M. S. Miner, D.M.D., M.D. 31 pages with 4 illustrations. $1.50. Boston, Research Publishing Company, Inc., 1957.

This monograph briefly describes the occupation of dental assisting, and discusses salaries, pension plans, working conditions, hours, and the demand for the services of dental assistants. It outlines the personal and educational qualifications necessary to succeed in this field, and offers suggestions on methods of securing employment.

The material which deals with the duties of the dental assistant is perhaps as complete as one could expect a 31-page, pocket size, monograph to offer. Three chapters are devoted to an outline of duties and instruction. Sources from which more detailed information and instruction can be obtained are indicated. There is brief information on study courses now available in some schools, and an outline of the subjects such courses usually include.

It does not present any particularly new information. However, this reviewer feels that the author has given a comprehensive summary of material, which he indicates has been distributed among various sources for some time.

It should be well worth its price to the young women seeking employment as a dental assistant, and to the one just beginning her career in this field. It could also be used to a good advantage by career counselors. For example, there is a page at the beginning of the

book which lists eight good reasons for becoming a dental assistant. This could be the decisive influence for the young girl who is considering a career in the field of health services. It also could be valuable to the dentist for use in employment interviews, or as a time saver in training an assistant in his office.—*Violet L. Crowley.*

■ NERVENREGENERATION UND TROPHIK (NERVE REGENERATION AND TROPHIC INFLUENCES). By M. L. Borowski. 195 pages with 77 illustrations. DM. 20. Jena, Gustav Fischer, 1956.

This is a research report recently translated from the original Russian publication of 1952. It is an account of experimental work done by Borowski and his co-workers in the Russian Institute for General and Experimental Pathology of the Academy of Medical Sciences of the USSR.

The first part, in six chapters, describes experimental morphologic studies in which intact and interrupted sciatic nerves of rabbits were injected with 6 mg. of vitamin B_1. In nonsectioned nerves, pathologic changes were noted in the lumbosacral segments and even on the intact (contralateral) side of the body, whereas injections of peripheral or proximal stumps of cut nerves led to pronounced dystrophies and even death of the animals. Pathologic changes were noted earlier in sensory than in motor nerves. The findings of widespread pathology after local treatment is given in support of Pavlov's notion of a pathologic nervous reflex mechanism. Part two (two chapters) covers clinico-physiologico-morphologic studies on patients and pieces of nerves removed in surgical operations; part three (one chapter) considers nerve regeneration and the trophic (beneficial, nutritive) functions of nerve. The results would be far more conclusive and convincing if the experiments had been conducted with a greater number of animals and with adequate controls. The halftone reproductions of photomicrographs are, in general, of poor quality.

The summary proves to be not so much a recapitulation of salient features of the research as a rather long, plodding review of the Russian literature. Foreign (non-Russian) countries are criticized not only for failing to develop a "settled, harmonious, materialistic doctrine" concerning the trophic role of the nervous system, but also for ceasing to work on the problem. The reason advanced to explain this is the "ideologic influence of reactionary theories which prevail in philosophy and natural science." One reads that in "capitalistic countries" work on the trophism of nerves is not progressing, but has even stopped—at present "nothing at all is being accomplished." The literature citations would seem to bear out such statements. As against 134 references to Russian articles, only 10 works in the English language and 16 in French and German are mentioned. The Russian references are given also in German.

The neurologist, neurophysiologist and neurosurgeon will find in this a rather thorough, if biased, discussion of the concept of the trophic influence of the nervous system on the body as a whole and its biodynamic processes.—*Vernon E. Krahl.*

■ TRACHEOTOMY—THEN WHAT? Richard L. Rapport, M.D., J. P. Rahm, M.D., and George Curry, M.D. Am. J. Surg. 93:550 April 1957.

Tracheotomy was first described as early as 124 B.C. Since that time its usage has increased until today when its use is common for acute laryngeal or pharyngeal obstructions caused by foreign bodies, infection, local trauma or chronic obstructive lesions and prolonged comatose conditions. Prophylactic tracheotomy is being performed with increasing frequency. Tracheotomy should be performed when first considered. A delay of several hours may endanger the patient's life.

Except in true emergencies, tracheotomy should be performed in the operating room. A sandbag or folded blanket should be placed beneath the patient's shoulders to hyperextend the neck. It is immaterial whether the incision is longitudinal or transverse. A longitudinal incision facilitates the procedure, but the transverse incision avoids an unsightly scar. The position of the trachea should be evaluated carefully to determine if it is in the midline. A tracheotomy tube of appropriate length should be selected. A short tube is difficult to maintain in position, whereas a long one may encroach on the carina and obstruct the main bronchus. The largest possible tube should always be utilized.

Oxygen should never be used routinely. It is a drying agent and tends to make secretions thick and more difficult to aspirate. In most instances when tracheotomy is indicated, respiratory difficulties are not due to oxygen deficiency. Although the use of atropine has been suggested to dry and reduce secretions, the authors believe that this is contraindicated and, conversely, efforts should be made to liquefy secretions so that they may be aspirated readily. Bronchospasm may be present and bronchodilators should be used judiciously.

The inner cannula should always be inserted after introduction of the tracheotomy tube. It should be removed and cleaned as necessary in order to prevent encrustations and plugs. After establishment of a tract at the end of three or four days, the entire tube should be removed and replaced daily. When the time for extubation approaches, the authors prefer replacement of the tracheotomy tube with progressively smaller ones, rather than trial occlusion. This prevents the false observation that corking is not tolerated since a large tube may fill the trachea and obstruct the airway. The smallest tube may then be corked before final removal.—*Irwin A. Small.*

■ HEMANGIOMA OF THE MANDIBLE. Charles S. Kilgour, M.D. Brit. J. Plast. Surg. 9:60 April 1957.

Although hemangioma of bone was formerly considered quite rare, it is now found fairly commonly, its usual site being the vertebral column. A review of the literature revealed only eight cases reported of hemangioma occurring in the mandible. Hemangiomas have been described as tumors of mesenchymal origin, probably growing from congenital rests by a process of endothelial proliferation, and differentiating into blood vessels. They are usually benign, and may become self healing. It has been stated that hemangioma of bone does not become malignant. Two roentgen-ray features of this lesion in long bones have been described: (1) a "fine soap bubble" appearance, and (2) a "sunburst" appearance of radiating trabeculations at right angles to the cortex, usually without expansion of the cortex.

Recommended treatment has been excision or curettement and cauterization, and one author reported that repeated irradiation resulted in gradual regression and healing.

Two additional case reports are given: treatment was excision of the lesion with resection of a portion of the mandible in one instance. In both patients the defects were repaired with iliac bone and complete healing ensued.—*William J. Amaral.*

■ SURGICAL ASPECTS OF CLEFT PALATE. James T. Metzger, M.D. Surg., Gynec. & Obst. 105:141 Aug. 1957.

Congenital lip and palate defects have been known since antiquity; in fact, Galen gave this deformity its present name, lagocheilos, meaning lip of a hare. It is felt that this malformation is the result of a defect in the arterial blood supply to this region, caused by the transfer from the internal carotid system to the external carotid system during fetal development. Cleft palate is frequently associated with other craniofacial anomalies such as Treacher-Collins, Francochetti, Apert, Klippel-Feil, Pierre-Robin and other forms of oxycephalia and hypertelorism.

The older technics of surgical closure include the von Langenbeck operation, osteoplastic procedures, closure by wire traction, the use of various mucosal flaps and closure by tissue from outside the mouth. The most satisfactory is the Wardill-Veau-Kilner operation which is in the form of a V-Y plasty which allows for an increase in palatal length. Where palatorrhaphy has been unsuccessful, a pharyngeal flap often can be used as a method for surgical obturation.—*Irwin A. Small.*

■ FACIAL AND NEUROCRANIAL GROWTH AFTER REMOVAL OF THE MANDIBULAR CONDYLE IN THE MACACA RHESUS MONKEY. Bernard G. Sarnat, M.D. Am. J. Surg. 94:19 July 1957.

Facial growth is a result of integration of activities in a number of regions, of which mandibular growth is an important one. Growth of the mandible proceeds in two ways: appositional at several borders and epiphyseal-like growth centers, while interference with these centers results in some type of mandibular deformity. The condyle functions as a pacemaker and organizer of mandibular growth and is the most important growth center. Effects of interference on the growing condyle and the extent of subsequent jaw deformity are determined not only by the severity and duration of the influence of a noxious agent but also by the time of its occurrence.

A previous report by the author described the effects of unilateral and bilateral condylectomy in young monkeys as observed from 4 to 17 months postoperatively. The purpose of this report was to demonstrate through a longer postoperative period that loss of condylar growth sites influences growth of the facial skeleton and neurocranium, in addition to affecting mandibular growth. Results at operated sites and sites that were not operated on were recorded and studied by means of lateral roentgenograms, photographs and microscopic sections. Gross and roentgenographic findings in the mandible and temporomandibular joint regions were more accentuated but similar to those of the earlier study. On the anterior and lateral aspects of skulls in which unilateral condylectomy had been performed, the total face height and width were less on the side which had been operated on, indicating less growth of mandibular and maxillary components. As a result of these changes, the occlusal plane was close to the level of the zygomatic arch and the external auditory canal on the side that was operated on. The central surface of the basilar aspect of the skull in instances in which condylectomy was carried out unilaterally showed deviation of anterior and posterior parts toward the operated side, but the dorsal basilar aspect showed no significant changes. Growth of the upper part of the facial skeleton is closely correlated with that of the mandible, which is perhaps the leading factor of facial growth. Growth of the neurocranium depends on the brain itself, whereas the masticatory skeleton is partly dependent on muscular influences, the growth of the tongue and the dentition. The articulation of the growing condyle in the mandibular fossa exerts an effect on the temporal bone and also on the zygomatic and sphenoid bones. The effect of the absence of one condyle was demonstrated by less development and posterior progression of growth of the temporal, sphenoid and zygomatic bones and a consequent asymmetry of the skull in all its aspects.—*William J. Amaral.*

Announcements

■ Armed Forces Institute Plans Course in Pathology of Oral Regions

"Pathology of the Oral Regions," the annual course sponsored by the dental and oral pathology branch of the Armed Forces Institute of Pathology, will be given March 24 to March 28 in Washington, D. C. Emphasis will be placed on malignant neoplastic disease. Color television will be utilized in the course.

Those in the federal dental services may make application through the normal channels. Civilians interested in enrolling in the course may apply to Col. Joseph L. Bernier, DC, chief of the oral pathology branch at the Institute.

■ Case Histories with Color Slides Available by Subscription

Case histories, including color slides of the oral condition, laboratory findings, medical background, roentgenograms and photomicrographs, with a general discussion of the disease, are available through the American Institute of Dental Medicine.

The cases are drawn from the broad field of dental medicine. A loose-leaf binder and a box for color slides are furnished to each subscriber to the case history service. Subscribers are also entitled to full membership in the Institute. Members of the American Dental Association or the American Medical Association or their equivalents in other countries are eligible to apply.

Further information is available from the secretary of the Institute, Mrs. C. Novembri, 2240 Channing Way, Berkeley 4, Calif.

■ Enlarged and Revised Edition of Accepted Dental Remedies Available

A new chapter on "The Management of Patients Receiving Medical Care" and structural formulas in easy-to-read type are features of the redesigned and enlarged 1958 edition of *Accepted Dental Remedies.*

The new edition has been thoroughly reorganized and revised by the Council on Dental Therapeutics. Chapters which have been enlarged include those on the "Handling of Emergencies in the Dental Office" and "Prescription Writing."

The 1958 edition of A.D.R. is available at $3 a copy from the Order Department of the American Dental Association.

■ Advanced Courses at Illinois, Pittsburgh and Minnesota

Applications are being accepted for the two and three year full-time courses to be offered by the University of Illinois beginning in September. Both programs carry credit toward a Master of Science degree. Further details are available from Daniel M. Laskin, department of oral and maxillofacial surgery, College of Dentistry, 808 S. Wood St., Chicago 12.

The graduate division of the School of Dentistry at the University of Pittsburgh is offering courses in the fields of oral surgery, orthodontics, pedodontics, periodontics, and prosthodontics leading to the Master of Science and Doctor of Philosophy degrees. Nondegree, full-time 12 month courses in general anesthesia and basic sciences are also available for qualified dental graduates. Additional information may be secured from the director of graduate education at the university.

Applications for enrollment in the advanced oral pathology course being offered during the week of April 28 through May 2 are being accepted by the University of Minnesota School of Dentistry. Interested persons may contact Robert J. Gorlin, chairman, division of oral pathology, at the school in Minneapolis.

■ American Cancer Society Clinical Fellowships Available

The American Cancer Society has announced that clinical fellowships at the senior resident level for the academic year 1959-60 may be applied for by institutions accredited by the Council of Medical Education and Hospitals of the American Medical Association. Training in the following fields may be given: internal medicine, malignant diseases, neurological surgery, obstetrics-gynecology, orthopedic surgery, otolaryngology, pathology, public health, roentgenology, surgery and urology. Application forms are available from the director of professional education, American Cancer Society, Inc., 521 W. 57th St., New York 19.

■ University of California to Open Graduate Oral Surgery Program

Announcement of a three year graduate program in oral surgery beginning July 1 is made by the University of California School of Dentistry. Training includes clinical and hospital experience and study in the basic sciences. The program is designed to fulfill the requirements of the American Board of Oral Surgery. Further information may be obtained from the school in San Francisco. Application blanks are available from the University of California graduate division in Berkeley.

■ Dental and Oral Pathology Registry Offers Aid to Association Members

A number of services and materials are available to members of the American Dental Association through the Association's Registry of Dental and Oral Pathology. This activity functions as part of the American Registry of Pathology at the Armed Forces Institute of Pathology, Washington, D. C.

Services available include consultation on diagnoses requiring microscopic interpretation, assistance in preparing manuscripts on subjects relating to oral pathology, and training programs for board candidates, teachers and practitioners.

Loan materials include microscopic slide sets, a roentgen ray study set on lesions of jaw bones, five categories of clinical study sets and one set on the effects of radiation.

Further information can be obtained from Joseph L. Bernier, registrar, Armed Forces Institute of Pathology, Washington, D. C.

■ Announce Program for Third Dental Education Workshop

The third of three workshops for the improvement of dental education will be conducted at the Hotel Statler, New York, April 11, 1958. Participants in the panel discussions include Gerald D. Timmons, dean of the School of Dentistry, Temple University, Philadelphia, Joseph J. Obst, Brooklyn, Russell A. Dixon, dean of the School of Dentistry, Howard University, Washington, D. C., and Ormonde J. McCormack, Syracuse, N. Y. Topics for the day are "Instructional Methods in Dental Education" and "Dental-Teacher Training for Dental School Faculties."

■ V.A. Medical Teaching Group Hospital Announces Internships and Residency

The Veterans Administration Medical Teaching Group Hospital of Memphis, Tennessee announces that two rotating dental internships and one residency in prosthodontia will be available for the year beginning July 1958. Information and application forms may be obtained from the chief of the dental service, Veterans Administration Medical Teaching Group Hospital, Memphis, Tennessee.

■ European Organization Plans Fifth Congress

The European Organization for Research on Fluorine and Dental Caries Prevention will hold its fifth congress from May 30 to June 1 at Brussels in connection with the World's Fair. The theme of the congress will be the physiologic effect of small doses of fluorine and radioisotopes in dental research.

Nonmembers are invited to attend. It is expected that more than 20 countries will participate.

■ Mount Sinai Accepts Internship, Residency Applications

The Dental and Oral Surgery Service of Mount Sinai Hospital, New York, is accepting applications for internships and residency for the calendar year beginning in July. Applications should be addressed to Max Fuchs, assistant director, 11 E. 100th St., New York 29.

■ Two Meetings of Oral Surgeons

The American Board of Oral Surgery will meet in Chicago April 5 through April 8. Leslie M. FitzGerald is secretary of the Board. . . . Daytona Beach, Fla., will be the scene of the meeting of the Southeastern Society of Oral Surgeons. The dates of the meeting are May 2 and 3. P. B. Whittington, Jr., is secretary of the group.

■ Fellows of American Academy of Oral Pathology to Meet in Washington, D.C.

The fellows of the American Academy of Oral Pathology will meet in Washington, D. C., March 29 through 31.

A symposium on odontogenic tumors will be held at the Armed Forces Institute of Pathology, Walter Reed Army Medical Center, on March 31. Also in conjunction with the meeting, the examination for elevation to fellowship will be given.

New officers of the Academy are Charles A. Waldron, president; Henry H. Scofield, first vice-president; Robert J. Gorlin, second vice-president. David Mitchell is the editor, and Col. Joseph L. Bernier is secretary-treasurer.

■ Fellowship in Oral Pathology Available at Pennsylvania

A fellowship in oral pathology, supported by the American Cancer Society and carrying a stipend of $3,600, is available at the Thomas W. Evans Museum and Dental Institute School of Dentistry, University of Pennsylvania. The fellowship provides for one year of study, beginning August 1, 1958.

Persons interested in applying should submit a life history and letters of reference to Dr. C. E. Wilde, Jr., department of pathology at the school, 4001 Spruce St., Philadelphia.

■ Continental Casualty Adds Rider for Certain Types of Dental Surgery

The Continental Casualty Company has attached a dental rider to all its hospital and surgical type policies. The rider will provide for certain types of dental surgery for patients confined in a hospital, without additional cost to the policyholder, Dr. Clem Martin, the company's medical director, announced in mid-January. The extension became effective on current policies January 1, 1958, and will be issued on all new hospital policies sold by the company.

Editorial communications

■ ORIGINAL COMMUNICATIONS—This journal invites concise original contributions in the broad field of clinical and experimental surgery of the mouth and associated structures, including roentgenology, diagnosis, anesthesia and oral surgical pathology. Articles are accepted for publication with the understanding that they are contributed solely to the JOURNAL OF ORAL SURGERY. All manuscripts are subject to editorial modification. Neither the editors nor the publishers accept responsibility for the views and statements of authors expressed in their communications.

■ MANUSCRIPTS—Manuscripts submitted for publication should be sent to Fred A. Henny, Editor, Henry Ford Hospital, Detroit, Michigan.

Manuscripts should be typewritten on one side of the paper only with double spacing and liberal margins. The author's name and abbreviated title of the article should appear at the top of each manuscript page. The original should be sent to the editor and a carbon copy retained by the author. Manuscripts will not be returned if accepted for publication.

References should be placed at the end of the article and should conform to the style of the Quarterly Cumulative Index Medicus; viz., name of author, title of article and name of periodical with volume, pages, month and year. They should be numbered and should appear in the same order as that of the superior figures inserted in the appropriate positions in the text.

■ ILLUSTRATIONS—Illustrations accompanying manuscripts should be unmounted and numbered. The author's name should appear on the margin or back.

Authors should insert figure numbers at appropriate places in the text. The original drawings, or glossy print photographs of them, should accompany the manuscript. Legends for illustrations are to be typewritten in a separate list with numbers corresponding to those on the photographs and drawings.

A reasonable number of halftone illustrations will be reproduced free of cost to the author, but special arrangements must be made with the editors for color plates, elaborate tables or extra illustrations. Copy for zinc cuts (such as pen drawings and charts) should be drawn and lettered in India ink or with black typewriter ribbon (carbon paper placed with carbon against back of sheet for bolder type). Ordinary blue or colors will not reproduce. Only good photographic prints or drawings should be supplied for halftone work.

■ CASE REPORTS—Case reports will constitute an important department of the journal and the editors welcome case reports that are of unusual clinical value or that present exceptional conditions of interest.

■ EXCHANGES—Letters, exchanges, reprints and all other communications relating to the JOURNAL OF ORAL SURGERY should be sent to the American Dental Association, 222 East Superior Street, Chicago 11.